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Field Operations and Enforcement Manual for Air Pollution Control

Vol. 1 organization and basic procedures

Pacific Environmental Services, Inc.

prepared for

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FIELD OPERATIONS AND ENFORCEMENT MANUAL FOR AIR POLLUTION CONTROL

VOLUME I:

ORGANIZATION AND BASIC PROCEDURES

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Stationary Source Pollution Control Programs
Research Triangle Park, North Carolina 27711

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APTD-1100

FIELD OPERATIONS AND ENFORCEMENT MANUAL FOR AIR POLLUTION CONTROL

VOLUME I:

ORGANIZATION AND BASIC PROCEDURES

Prepared by
Melvin I. Weisburd
Pacific Environmental Services, Inc.
2932 Wilshire Boulevard
Santa Monica, California 90403

for

System Development Corporation
2500 Colorado Avenue
Santa Monica, California 90406

Contract No. CPA 70-122

Prepared for

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Stationary Source Pollution Control Programs
Research Triangle Park, North Carolina 27711

August 1972

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FOREWORD

The Field Operations and Enforcement Manual for Air Pollution Control presents field surveillance and enforcement techniques that can be applied by state and local air pollution control agencies to meet ambient air quality objectives. Inspection and enforcement techniques are described to reflect current air pollution control technology and specified sources of air pollution. It is intended as a guide for air pollution control agencies in carrying out their responsibilities in field surveillance, facility inspection, emission source evaluation and enforcement activities.

This manual draws heavily upon such publications as the Air Pollution Engineering Manual, Control Techniques Documents, Air Pollution (Academic Press) and numerous reports and documents produced by, and under contract to, the Environmental Protection Agency. It also updates and expands much of the material which appeared in the original Air Pollution Control Field Operations Manual prepared by the Los Angeles County Air Pollution Control District in 1960 and published by the U. S. Public Health Service in 1962. In addition, much new material was compiled from visits to nine air pollution control agencies and selected industrial facilities in 1970 and 1971 under Contract CPA 70-122 with the Environmental Protection Agency.

In establishing the scope of the manual, the following questions were considered:

- What are the activities and functions performed by field personnel?
- What do enforcement personnel need to know about their role in attaining and maintaining emission standards to achieve air quality objectives?
- What do enforcement personnel need to know about industrial source operations and control technology in order to perform effectively?
- What "inspection points" should be covered by enforcement personnel when observing and inspecting processes and equipment at specific sources of air pollution?
- What skills and equipment do enforcement personnel need in order to perform effectively?

- What systems and procedures are required for the collection and management of field data and successful execution of enforcement actions in order to attain and to verify the degree of source compliance desired?

These questions suggest that the scope of the manual is necessarily broad. Knowledge of air pollution control technology has greatly expanded since the publication of the original manual in 1962, with the result that the traditional distinction between the enforcement officer and the air pollution control engineer has become blurred. Field enforcement officers require far more than an inspection check list. They must possess knowledge of modern-day technology, manufacturing and production processes and the nature of air pollution problems. They also are in a reporting role and must relate to, and communicate with, the owners and operators of industrial facilities. Without such knowledge and skills enforcement personnel would lack the necessary confidence and understanding to observe and enter plants, obtain relevant information from interviews and process data, record instrument readings and inspect equipment to establish compliance with emission standards and equipment certification requirements.

This manual concentrates on the information and skills that are needed to accomplish the above. It can be used as a training document, a reference manual or as a guide to field activities. Although certain inspection techniques and enforcement practices have been used as "models," no attempt has been made to codify them. These must be developed or modified by the agencies responsible for controlling air pollution in the individual air quality control jurisdictions of the United States.

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Much of the information contained in this manual was obtained from interviews and materials supplied by staff members of state and local air pollution control agencies as a part of the field work performed under CPA 70-122. The authors are particularly indebted to the following agencies and individuals:

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The Field Operations and Enforcement Manual for Air Pollution Control is divided into three separate volumes.

Volume I, Organization and Basic Procedures, contains Chapters 1 through 4.

Volume II, Control Technology and General Source Inspection, contains Chapters 5 and 6.

Volume III, Inspection Procedures for Specific Industries, contains Chapter 7.

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CHAPTER 1

AIR QUALITY MANAGEMENT

I. INTRODUCTION

Air pollution control field operations consist of those surveillance and enforcement activities conducted by an environmental or air pollution control agency to secure certain and continuing control over the sources of air pollution. The mission of the field operations program as a whole is to implement the plans that have been adopted to achieve acceptable levels of air quality.

The role of field operations in air pollution control has changed considerably over the many years that air pollution has become a problem to civilization. Early efforts to control air pollution were largely concerned with the abatement of black smoke emitted from the inefficient combustion of coal used to generate power and heat homes. Smoke abatement agencies were organized in the United States and abroad around the turn of the century. These gave rise to the first smoke or combustion inspectors and set the pattern for air pollution control for many years.

The 20th Century experienced a profound change in the nature and extent of air pollution. Unlimited production; accelerated consumption of products, fuels and energy; the introduction of new chemical and petrochemical processing industries and atomic energy; the vastly increased use of the automobile; the growth of urbanization, all greatly increased the varieties and volumes of pollutants, thereby presenting new threats to health, plant life, property and the environment.

To cope with the current forms of air pollution, environmental control agencies must employ strategies and management tools that are at least equal to the inherent difficulties of the problem. While much progress has been made in improving our scientific and technical understanding of air pollution and its control, the major challenge of implementing the best of the technology available to control air pollution on a national scale is still before society.

The responsibility for fulfilling air pollution control objectives belongs to the enforcement branches of air pollution control agencies across the nation. Enforcement staffs will require highly trained and dedicated personnel. For this reason, the title "inspector," a carry-over from the industrial pollution era, is no longer adequate. The term "field enforcement officer" more accurately describes the scope of responsibility that must be fulfilled in the field.

This chapter offers an overall presentation of the nature and extent of contemporary air pollution problems, and describes the elements of an effective air quality management program in terms of control strategies, legislation, organization and staffing. The bulk of the manual presents specific surveillance and enforcement methods and administrative systems and procedures that can be implemented to achieve air quality objectives.

II. THE AIR POLLUTION POTENTIAL

The air pollution potential may be defined as the capacity of human activities conducted within any defined community or geographical area to pollute the atmosphere. It is sometimes referred to as emission rates or source strength, and is expressed in terms of the specific contaminants and the rates at which they are emitted from their sources. Air quality is a pattern, or profile, of the concentrations of contaminants in the ambient atmosphere and is expressed in terms of frequencies, averages or other statistical measures.

Air quality is not a function of source strength alone, but rather of the source strength and intervening meteorological and environmental influences. This section describes the major categories of sources of air pollution and the types of contaminants found particularly in metropolitan areas of the United States. Section III describes the major meteorological influences on air quality.

A. Sources of Air Pollutants

Air pollutants may be classified in two broad categories:(1) natural and man-made.

Natural sources of air pollutants include:

wind blown dust
volcanic ash and gases
ozone from lightning and the ozone layer
esters and terpenes from vegetation
smoke, gases and fly ash from forest fires
pollens and other aeroallergens
gases and odors from natural decomposition
natural radioactivity.

Such sources constitute background pollution and that portion of the pollution problem over which control activities can have little, if any, effect.

Man-made sources cover a wide spectrum of chemical and physical activities, and are the major contributors to urban air pollution. Air pollutants in the U.S. pour out from over 90 million vehicles, from the refuse of over 204 million people, the generation of billions of kilowatts of electricity and the production of innumerable products demanded by every-day living. Almost 300 million tons of air pollutants are generated annually in the United States alone. The five main classes of pollutants, particulates, carbon monoxide, hydrocarbons, nitrogen oxides and sulfur oxides are summarized for the year 1969 in Table 1.1.(2)

TABLE 1.1. ESTIMATED NATIONWIDE EMISSIONS, 1969 (10^6 tons/year)

Source	CO	PART	SO_x	HC	NO_x
Transportation	111.5	0.8	1.1	19.8	11.2
Fuel combustion in stationary sources	1.8	7.2	24.4	0.9	10.0
Industrial processes	12.0	14.4	7.5	5.5	0.2
Solid waste disposal	7.9	1.4	0.2	2.0	0.4
Miscellaneous	18.2	11.4	0.2	9.2	2.0
Total	151.4	35.2	33.4	37.4	23.8

(SOURCE: EPA, Reference 2)

B. Classification of Air Pollutants

For convenience, all air contaminants may be classified in two physical states: particulate matter and gaseous substances. The former is often subdivided into solid and liquid particulates while the latter is divided into true gases and vapors.

Particulate Matter

Solids: dust
fumes
smoke
aerosols

Liquids: droplets
mists
fogs
aerosols

Gases

True Gases: sulfur dioxide
nitrogen oxides
ozone
carbon monoxide

Vapors: gasoline
paint solvents
dry cleaning agents

Characteristic properties of the various airborne contaminants are important in considering their potential role in air pollution. Among these are:

a. Physical properties such as particle size, shape, surface area, density, electrical charge, radioactivity and vapor pressure.

b. Chemical properties such as acidity, alkalinity, solubility, hygroscopicity, reactivity and corrosiveness.

c. Biological properties such as toxicity, taste and odor.

C. Particulate Matter

A particle is any dispersed matter, solid or liquid, in which the individual aggregates are larger than single molecules, but smaller than about 500 micro-meters in diameter.(3) A continuous spectrum of sizes occurs among the particles in the atmosphere, with corresponding gradations in physical and chemical properties. Figure 1.1 illustrates the size range and some common characteristics.(4)

Variations in size confer different physical and chemical properties on the particles. It is important, therefore, to be familiar with the scale and size ranges of common particulate substances and corresponding changes in properties. For example:

- A micro-meter* is equal to 1/1,000 of a millimeter, or 1/25,000 of an inch.

---

*The term micron is also frequently used in the literature.

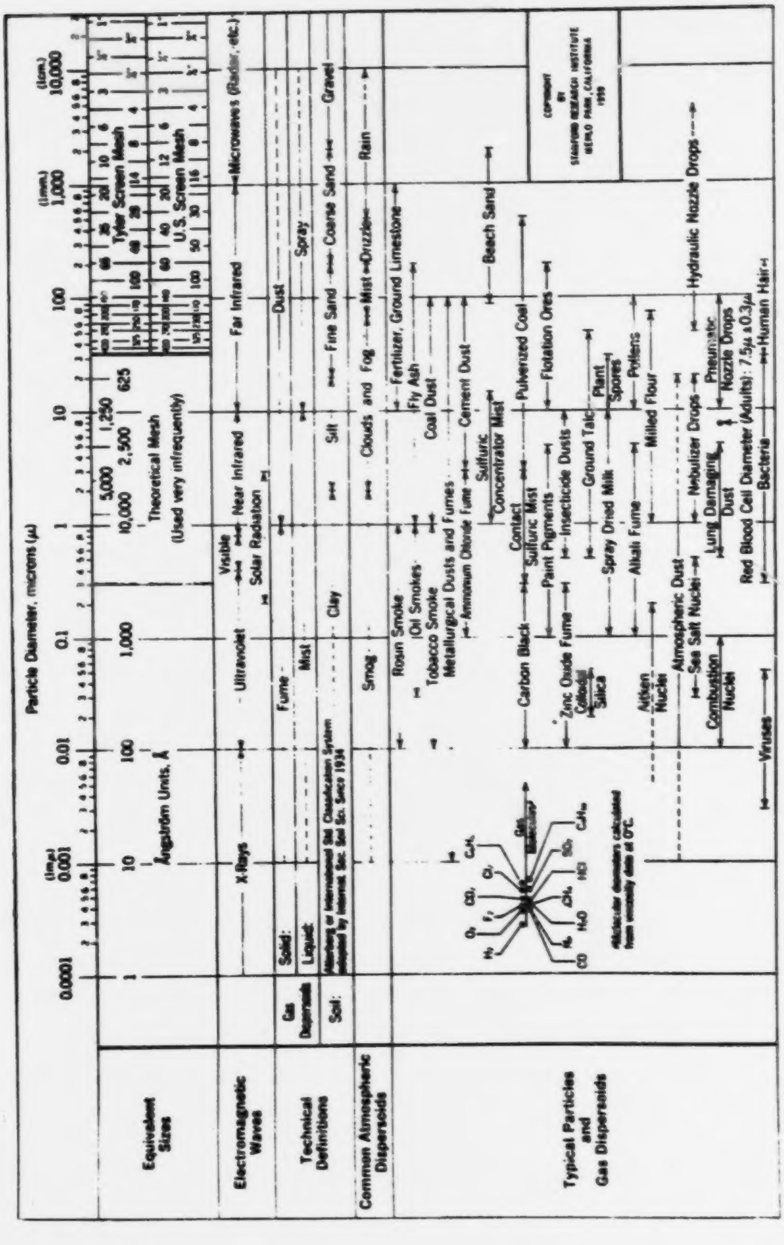
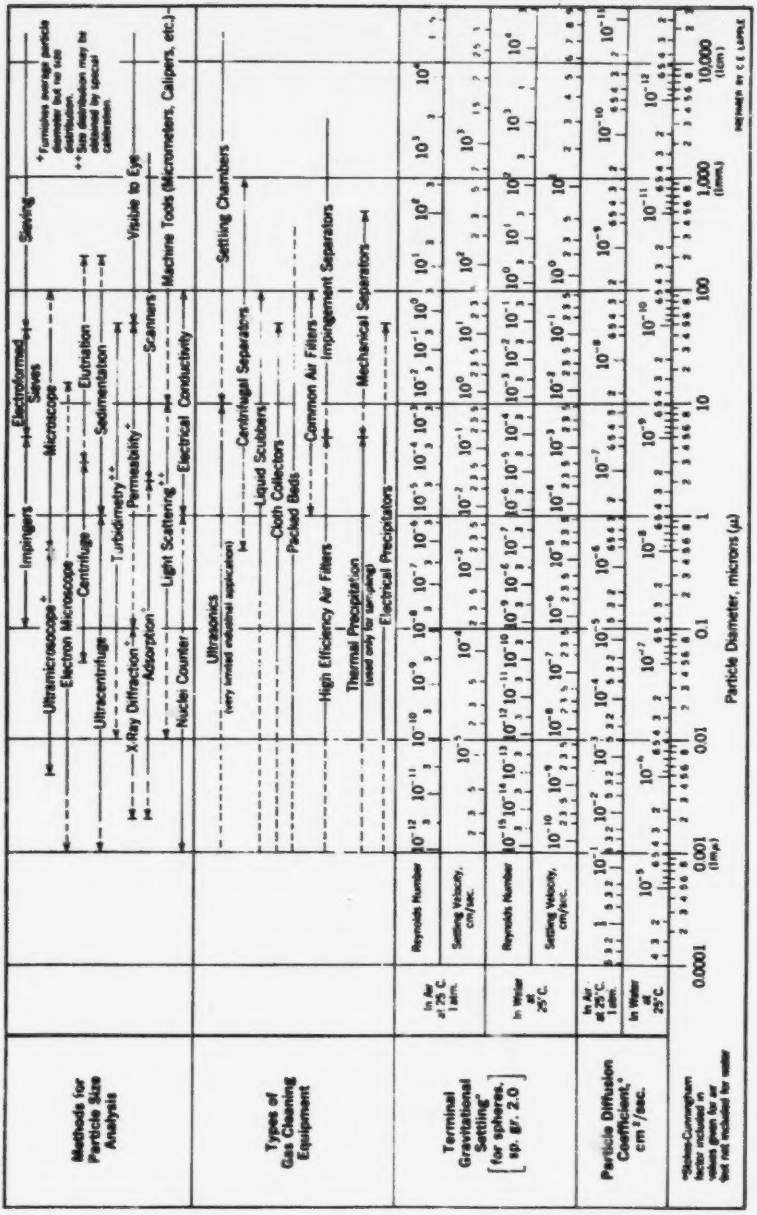


Figure 1.1. CHARACTERISTICS OF PARTICLES AND PARTICLE DISPERSOIDS.

(SOURCE: SHEEHY, ET. AL., Reference 4)


Methods for Particle Size Analysis
Types of Gas Cleaning Equipment
Terminal Gravitational Settling* [for spheres, sp. gr. 2.0]
Particle Diffusion Coefficient,* cm²/sec.
In Air at 25°C 1 atm.
In Water at 25°C
Reynolds Number
Settling Velocity, cm/sec.
Ultramicroscope+
Electron Microscope
Impingers
Microscope
Electroformed Sieves
Sieving
Ultracentrifuge
Centrifuge
Elutriation
Sedimentation
Turbidimetry++
X-Ray Diffraction++
Permeability+
Adsorption+
Visible to Eye
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Scanners
Nuclei Counter
Electrical Conductivity
Machine Tools (Micrometers, Calipers, etc.)
Ultrasonics (very limited industrial application)
Settling Chambers
Centrifugal Separators
Liquid Scrubbers
Cloth Collectors
Packed Beds
Common Air Filters
Impingement Separators
High Efficiency Air Filters
Thermal Precipitation (used only for sampling)
Mechanical Separators
Electrical Precipitators
0.0001
0.001 (1mμ)
0.01
0.1
1
10
100
1,000 (1mm)
10,000 (1cm)
Particle Diameter, microns (μ)
+Furnishes average particle diameter but no size distribution.
++Size distribution may be obtained by special calibration.
*Stokes-Cunningham factor included in values given for air but not included for water
PREPARED BY C.E. LAPPLE

Figure 1.1. CHARACTERISTICS OF PARTICLES AND PARTICLE DISPERSOIDS. (continued)

- Viruses are between 0.01 and 0.1 micro-meter in size.
- Bacteria are between 1 and 25 micro-meters in size.
- Fog droplets are between 5 and 60 micro-meters in size.
- Raindrops are between 400 and 5,000 micro-meters in size.
- Particles approximately 10 micro-meters in diameter are barely visible to the naked eye.

1. Particulate Size Ranges

Coarse dust particles larger than 10 micro-meters in diameter and fly ash, composed of the impurities remaining after coal is burned, settle out of the air quickly. They are, therefore, usually troublesome only near their source. Fume, dust, and smoke particles range in size from under 1 to 10 micro-meters. They tend to travel farther than coarser particulates, depending on their size.

Particles less than 1 micro-meter in diameter (generally referred to as aerosols because they are small enough to remain suspended in the air) move as easily and as far in wind or air currents as gases do.

Polluting particles are composed of a variety of substances originating from the myriad activities conducted by man. Because their size and, to a lesser degree, their physical state influence their behavior so greatly, they are commonly identified by the appearance and behavior of the emissions in which they are contained. For example:

- Smoke describes unburned carbonaceous particles mostly 1 micro-meter in diameter produced as a result of combustion.

- Fume indicates the solid particles under 1 micro-meter in diameter that are formed as vapors condense or as chemical reactions take place. Fumes are emitted by many industrial processes, including metal smelting and refining, distillation, and removal of solid impurities by boiling liquid materials and condensing the vapors.
- Dust is a more general term than fume. When solid particles are more than 1 micro-meter in size they are generally referred to as dust. Dust may be formed by natural processes or in innumerable mechanical operations conducted at industrial and agricultural facilities.
- Mist consists of liquid particles up to 100 micro-meters in diameter. They may be released in such industrial operations as spraying and impregnating, or formed by the condensation of vapor in the atmosphere. As mists evaporate, more concentrated liquid aerosols may be formed.

2. The Properties of Particulates

When a liquid or solid substance is emitted to the air as particulate matter, its properties and its effects may be changed. As a substance is broken up into smaller and smaller particles more of its surface area is exposed to the air. Under these circumstances, the substance--whatever its chemical composition--tends to physically or chemically combine with other particulates or gases in the atmosphere. The resulting combinations are frequently unpredictable.(5) For example:

- Very small aerosols (from 0.001 to 0.1 micro-meter in diameter) can act as nuclei on which vapor condenses. Fogs, ground mists and rain may thus be increased and prolonged.

- Particles less than 2 or 3 micro-meters in size--about half (by weight) of the particles suspended in urban air are estimated to be that small--can penetrate into the part of the lung which is unprotected by mucous, and can attract and carry such harmful chemicals as sulfur dioxide with them. Sulfur dioxide alone would be dissolved on the mucous before it reached that vulnerable tissue.
- Particulates can act as catalysts. (Catalysis is the process in which a chemical reaction is speeded up by a substance that remains unchanged itself. The unchanged substance is known as the catalyst.) An example of this is the change of sulfur dioxide to sulfuric acid, aided by the catalytic action of iron oxides.
- Aerosols can absorb radiant energy and conduct heat quickly to the surrounding gases of the atmosphere. These are gases that are incapable of absorbing radiant energy by themselves. As a result, the air in contact with the aerosols becomes much warmer. Some scientists fear that the increasing aerosol emissions of jet planes high in the troposphere may eventually form a heat-absorbing layer that will diminish the penetration of the sun's rays to the earth.

3. The Prevalence of Particulates

The urban atmosphere is comparatively dense with particulates. Los Angeles estimates its aerosol emissions from gasoline-powered vehicles at 40 tons a day. An average winter day in New York City produces an estimated 335 tons of particulate matter. In Kansas City, dustfall in the winter measures more than 67 tons per square mile each month. In the most heavily polluted parts of major cities from 50 to more than 100 tons of particulates fall each month per square mile. In general, the concentration of aerosols in the air over a city is related to the size of its population.

Automobile exhaust emits especially large amounts of very fine aerosols. More than two-thirds of automobile emissions are between 0.02 and 0.06 micro-meters in size. One hundred billion particles per cubic meter of air may be produced from chemical reactions which occur between these emissions and other atmospheric contaminants.

D. Gaseous Contaminants

The gases of importance as air pollutants come from a wide range of organic and inorganic compounds. The most common are carbon monoxide, sulfur oxides, nitrogen oxides and hydrocarbons. These are tabulated in Table 1.1. These estimates also show that gaseous contaminants represent over 88 percent by weight of all pollutant emissions. Carbon monoxide is the most significant, since it amounts to almost 55 percent by weight of all pollutant emissions.(6)

1. Sulfur and Its Compounds

Sulfur, (S), the oxides of which are a major reason for many cities' pollution troubles, is itself a nonmetallic element found in nature either in free form or combined with other elements. It is almost invariably present as an impurity in the coal and fuel oils that are basic to most combustion and power sources.

a. Sulfur Oxides

When fuels containing sulfur are burned, the sulfur joins with the oxygen of the air and gaseous oxides of sulfur are formed. Fuel combustion is the major source of the polluting sulfur oxides, although they are also produced in chemical plants and, to a lesser degree, by processing metals and burning trash.(7)

The major oxide of sulfur that is produced in combustion is sulfur dioxide (SO_2), a heavy, pungent, colorless gas that dissolves easily in water vapor to form a solution of sulfurous acid (H_2SO_3). Sulfurous acid, mildly corrosive, is used as a bleaching agent in industry. It joins slowly with the oxygen in the air (or quickly if catalysts are present) to become the even more corrosive, irritating mist, sulfuric acid (H_2SO_4).

Sulfur acid can also be formed by a different route. Sulfur dioxide can be oxidized directly (changed chemically by combining with oxygen) to sulfur trioxide (SO_3), which can be either a colorless liquid or a white solid aerosol. Sulfur trioxide is a likely product when combustion takes place with excess oxygen. The change is abetted by the catalytic action of some of the ash residue, especially the iron oxides that form on boiler tubes and walls. As sulfur dioxide leaves the smoke stack it usually diffuses rapidly, so that oxidation to sulfur trioxide takes place rather slowly. But, with time, sulfur trioxide can build up substantially and react very quickly with water vapor to form sulfuric acid.

Sulfur oxides can damage vegetation, fabrics and building materials, limit visibility, cut down the light from the sun, and affect human breathing. At sufficiently high concentrations, sulfur dioxide irritates the upper respiratory tract. At lower concentrations and when carried on particulates, it appears able to cause still greater harm by injuring lung tissue.

b. Other Sulfur Compounds

Other undesirable sulfur compounds include hydrogen sulfide gas (H_2S), which gives off the foul odor of rotten eggs, and two classes of sulfur compounds called mercaptans and sulfides, which are associated with unpleasant odors such as garlic, onions, skunk or decayed cabbage. These gases are familiar by-products of petroleum refining, kraft pulping for paper production and various chemical processes.

In addition to giving off an annoying smell, hydrogen sulfide can tarnish silverware and copper bowls and, by darkening the lead in paint, it can ruin the exteriors of houses. Fortunately, there is rarely enough hydrogen sulfide in the air to harm either vegetation or man.

2. Carbon and Carbon Oxides

Carbon (C) is a nonmetallic element found either in its pure state or as a constituent of coal, petroleum, limestone and other organic and inorganic compounds. (The term organic is used to describe most carbon-containing compounds.) Carbon compounds are most frequently used as fuels, and the combustion process liberates much of the carbon, either as unburned or partly burned particles or as carbon monoxide or carbon dioxide.

a. Carbon Monoxide

One product of incomplete combustion is carbon monoxide (CO), a colorless, odorless, very toxic gas. No other gaseous air pollutant is found at such relatively high concentrations in the urban atmosphere.(8)

Its effects in the metropolitan air are uncertain. Controlled laboratory experiments show that at exposures of approximately 100 ppm (parts per million) most people get dizzy, develop headaches and feel other symptoms of poisoning. A concentration of 100 ppm is not uncommon today in heavy traffic. Some studies have measured 370 ppm inside vehicles in traffic jams. Yet a study of 237 people involved in traffic accidents in Detroit failed to show that their driving ability was impaired by the carbon monoxide in the atmosphere of that city at the time of their accidents.

The fate of carbon monoxide in the atmosphere is unknown. Although more than 300 million tons of carbon monoxide are formed each year throughout the world, enough to double the global concentration in about 5 years, careful measurements have shown that the average concentration has not changed over the last 50 years. What happens to carbon monoxide is a mystery.

b. Carbon Dioxide

Carbon dioxide (CO_2), a heavy, colorless, odorless gas, is formed during combustion; the more complete the combustion, the more CO_2 is formed. It is also formed in nature by the decomposition of organic substances and it is absorbed from the air by plants through the mechanism of photosynthesis.

Carbon dioxide is not normally considered an air pollutant because it performs a necessary function in life processes. Even the increasing amounts produced by man's activities are far from enough to endanger him.

The presence of sufficient quantities of carbon dioxide, however, can have undesirable side effects. In the presence of moisture it converts to carbonic acid and erodes stone. It is partially responsible for the corrosion of magnesium and perhaps of other structural metals as well. And it is believed that the huge amounts of carbon dioxide emitted each day are very slowly heating the earth's atmosphere. In time, some scientists fear, this scarcely perceptible rise in temperature may cause the partial melting of the polar icecaps and extensive flooding throughout the world.

3. Hydrocarbons

Hydrocarbons are a class of compounds containing carbon and hydrogen in various combinations. They are found most abundantly in petroleum, natural gas and coal. Some are gaseous, some liquid, some solid, and all in all they make up a vast family of chemicals. There are, in fact, thousands of hydrocarbon compounds. Most of these compounds, fortunately, are harmful only in very high concentrations. A few may be extremely toxic, however, and need to be examined very carefully.(9)

Two groups of hydrocarbon compounds are of great importance in air pollution: (1) the olefin or ethylene series and (2) the aromatic, benzenoid or benzene series.

a. Olefins

The olefins are a group of unsaturated hydrocarbons. (Unsaturated compounds react easily with other chemicals.) Most olefins in small concentrations appear to have no direct effect on animal life, although some cause a general reduction in plant growth. In addition, olefins take part in photochemical reactions with nitrogen oxides and several other classes of compounds. The deleterious effects of these reactions are described later in this chapter.

b. Aromatics

Included in the aromatics are a number of compounds believed or known to be carcinogenic (cancer-producing). The most potent of these is benzpyrene (often written benzo(a)pyrene or 3, 4 benzpyrene). A primary source of these carcinogens is the incomplete combustion of organic materials. In fact, most polluting hydrocarbons are discharged into the air by incomplete combustion. And the major source of this kind of contamination is the burning of gasoline in automobiles.

Hydrocarbons can also be released into the atmosphere by evaporation. The oil industry encompasses many operations that produce hydrocarbon vapors. Among these are cracking (the chemical decomposition of oil under intense heat), gasoline storage and tank truck filling. Some hydrocarbon vapors have objectionable odors; some take part in photochemical reactions; some have toxic properties. Other constant vapor emitters include alcohols, esters and paint and lacquer thinners.

4. Nitrogen Oxides

Nitrogen (N) itself is a colorless, tasteless, odorless gas that constitutes 78 percent of the atmosphere. A number of oxides of nitrogen occur, but only nitric oxide and nitrogen dioxide are considered pollutants. These have been called status symbol or jet-age pollutants, because, ironically, only a highly advanced country is likely to suffer seriously from them.(10)

a. Nitric Oxide

The colorless, somewhat toxic gas, nitric oxide (NO) is formed when combustion takes place at temperatures sufficiently high to cause a reaction between the nitrogen and oxygen of the air. Temperatures this high are reached only in efficient combustion processes or when combustion takes place at high pressure. Thus, nitric oxide is formed primarily in automobile cylinders, electric power plants and other very large energy-conversion processes.

In most cities the automobile is the largest single source of this compound. The nitric oxide formed at the high temperatures of the cylinder air moves so rapidly to the cooler exhaust pipe that it is prevented from decomposing back to nitrogen and oxygen, as it would if cooling were slower.

b. Nitrogen Dioxide

Nitric oxide, which is relatively harmless, is the form generally emitted into the atmosphere. But varying amounts of nitric oxide are converted to nitrogen dioxide (NO_2), which causes considerably more trouble.

The oxidation of nitric oxide to nitrogen dioxide is very rapid at high concentrations in air, but is slow at low concentrations except in the presence of hydrocarbons and sunlight. Thus, although more nitric oxide is formed in Chicago than in San Francisco because of the more abundant sunshine in the latter city, San Francisco has a higher atmospheric concentration of nitrogen dioxide than Chicago.

Since nitrogen dioxide is formed so readily by photochemical action, it is usually thought of as a product of the photochemical process. But actually it may be formed whenever nitric oxide is a by-product of sufficiently high burning temperatures, with or without photochemical action. It is also a product or by-product of a number of industries, including fertilizer and explosives manufacturing.

Nitrogen dioxide is the only important and widespread pollutant gas that is colored (yellow-brown). As a result, it can significantly affect visibility. It has a pungent, sweetish odor detectable at 1 to 3 parts per million, fortunately a level seldom reached in polluted atmospheres.

At sufficiently high concentrations, nitrogen dioxide can be fatal, but such amounts are highly unlikely. Prolonged exposures at ordinary concentrations may also be harmful to the lungs, though little experimental data are available.

Nitrogen dioxide reacts with raindrops or water vapor in the air to produce nitric acid (HNO_3), which, even in small concentrations, can corrode metal surfaces in the immediate vicinity of the source. Vegetation, too, can be injured when it grows close to factories handling large amounts of nitric acid. The nitrogen oxides present in the ordinary community's air, however, are probably always too low to damage plant life.

5. Photochemical Products

The numerous references to photochemical reactions indicate their importance in the air pollution problem. Once they were thought to be of concern only in Los Angeles; now they are observed even in the smaller cities throughout the nation.(11)

Photochemical reactions are a complex series of atmospheric conditions involving hydrocarbons and oxides of nitrogen. The chemical reactions are initiated by the action of sunlight on nitric oxide. Many of the resulting products have been identified, others have not. Two major characteristics of this complex reaction system are the general haziness imparted to the atmosphere and eye irritation. The name "smog" was early given to this condition, since it was thought to be a combination of smoke and fog. Subsequent studies have shown that neither smoke nor fog is involved, but the name has remained.

In general, one or more photochemical smog products, either alone or in combination, can cause eye irritation, breathing difficulty, vegetation damage, deterioration of materials and decreased visibility. Some of the principal features and components of this system are described below.

a. Oxidant

Oxidant is a term used by many air pollution control experts in two ways: one describes the capacity of certain oxygen-containing substances to react chemically in polluted air to form new products. In this sense, oxidant is a general measure of smog formation activity. The term is also used to describe the chemical substances that make oxygen available for this reaction.

Any oxygen-bearing compound, such as nitrogen dioxide, that takes part in the photochemical reaction can be termed oxidant. But ozone is the substance whose name is used almost interchangeably with oxidant. This is because ozone usually comprises the bulk of the measured oxidant and is an early and continuing product of the photochemical smog reaction.

b. Ozone

Early in the photochemical process ozone (O_3), a colorless, pungent gas, is formed. Ozone is an allotropic form of oxygen; i.e., it is composed of oxygen and will react chemically to form the same compounds, but its composition and properties are different. A molecule of ozone consists of three atoms of oxygen instead of two as in ordinary oxygen. And, quite unlike oxygen, ozone can cause coughing, choking, headache and severe fatigue. It can damage the leaves of plants, crack rubber, deteriorate fabrics and fade colors.

c. PAN and Aldehydes

Another smog product often mentioned is PAN, short for peroxyacyl or peroxyacetyl nitrate. Although it has been studied for only a few years, it is known to make the eyes burn and tear. It has the same irritating effect on the lungs as ozone and other oxidants, and it can damage plants.

Still another group of photochemical products is the aldehydes. These result from the union of certain hydrocarbons with oxygen. They are colorless and, in high concentrations, have a suffocating, pungent, irritating odor. Aldehydes are strong irritants of the eyes, skin and respiratory tract.

Aldehydes are also present in the exhaust emissions of automobiles as products of incomplete combustion of fuel.

III. METEOROLOGICAL INFLUENCES ON AIR QUALITY

The elimination of, or large reductions in, air pollution can only be accomplished by controlling the sources of emission. The practical problem that must be dealt with, however, is balancing the costs of reducing air pollution emissions against the amount of reduction that is required to achieve acceptable air quality levels. This amount of emission reduction is a function of meteorological conditions and their variations in time and space.(12)

The atmosphere is the medium by which air pollutants are transported away from their sources of emission. For a given source strength, atmospheric motions govern the length of time and the frequency to which receptors (humans, materials, vegetation, etc.) will be exposed at varying distances from a source. Principal meteorological influences include air flow, topography, vertical mixing, dispersion and others described below. While these influences are discussed individually, they generally act in concert. In some situations a combination of influences (for example, limited vertical mixing together with low wind speeds) may set the stage for a serious air pollution episode.

A. Air Flow

The most important parameter in the movement of contaminants by the atmosphere is the wind. The greater the wind speed, the greater the turbulence and the more rapid and complete is the dispersion of contaminants in the atmosphere.

Since temperature gradients, both horizontal and vertical, increase during the winter season, the speed of the wind flow is generally increased during this time of year. However, occasions occur in winter when prolonged periods of little or no air motion may occur. A study(13) of the frequency of prolonged periods of light air flow east of the Rocky Mountains in the continental U.S.A. shows that such situations happen most often in late spring and early autumn.

In addition to the seasonal change, diurnal changes in wind flow occur at many locations. Night hours are usually periods of low-level stability at most areas within the continental U.S.A. As a result of the effects of negative buoyancy and the increased energy required for vertical motions, pollutants disperse slowly and may be confined in relatively small volumes. The concurrent light, variable wind may even result in a return flow of material across the original source. In contrast, the daytime winds are apt to be more turbulent, of higher speeds, and the vertical motions are enhanced, so that the maximum dilution of material occurs on clear, sunny days.

The local winds may differ markedly from the general air flow that characterizes the region. Along the coasts of continents or of the larger lakes, the temperature differential between the land and water is sufficient to establish local circulations from sea to land during the day and from land towards sea during the night. At most locations, these sea-breeze regimes are well marked only during the summer and are masked by the general wind flow during the other seasons. However, in subtropical areas, such as southern California coastal areas, they may be the dominant weather pattern and occur with almost clock-like regularity from day to day.

B. Topography

In addition to the sea-breeze conditions of coastal areas, the topography of an area may be important. Where the air flow is markedly restricted by terrain, the flow may be persistently and continuously channeled to a single direction or confined in a relatively small area. Within a fairly narrow valley, the characteristic daily wind pattern is a flow up the valley and the slopes in the daytime, due to solar heating, while just before or just after sunset, the wind reverses flowing down the slopes and into the valley. Contaminants released within the valley may be effectively trapped within a small area for long periods. In addition, the shielding from the effects of general circulation patterns afforded by the valley walls will result in lower wind speeds along the valley floor than would be the case in comparably level terrain.

C. Vertical Mixing

Turbulence, or eddy motion, consists essentially of mechanical and thermal turbulence. Mechanical turbulence is induced by the movement of wind over the aerodynamic rough surface of the earth and is proportional to the roughness of the surface and to the wind speed. Thermal turbulence is solar-induced and is a function of latitude, the radiating surface and the stability of the atmosphere. It is at a maximum during the summer on clear days and at a minimum during the long winter nights. When the vertical temperature gradient of the lower atmosphere is greater than the adiabatic lapse rate, vertical motions are enhanced, and dispersion, particularly in the vertical, is more marked. On the other hand, in a stable atmosphere, when the temperature gradient is isothermal or positive with altitude, considerable energy must be expended in achieving vertical motion. Figure 1.2 depicts the diurnal variation of vertical mixing.

A typical daily cycle of temperature gradient over open country on a cloudless day begins with the build-up of an unstable lapse rate, which increases during the daytime owing to strong solar heating and associated well-developed turbulence conditions. Just before or shortly after sunset, the air near the ground cools rapidly and a stable lapse rate or temperature inversion (temperature increasing with altitude) begins to form. The inversion increases with time in intensity and in depth during the night, reaching a maximum between midnight and the time of minimum surface temperature. During this period, contaminants are effectively trapped within or below the inversion layer with little or no vertical dispersion. It should be

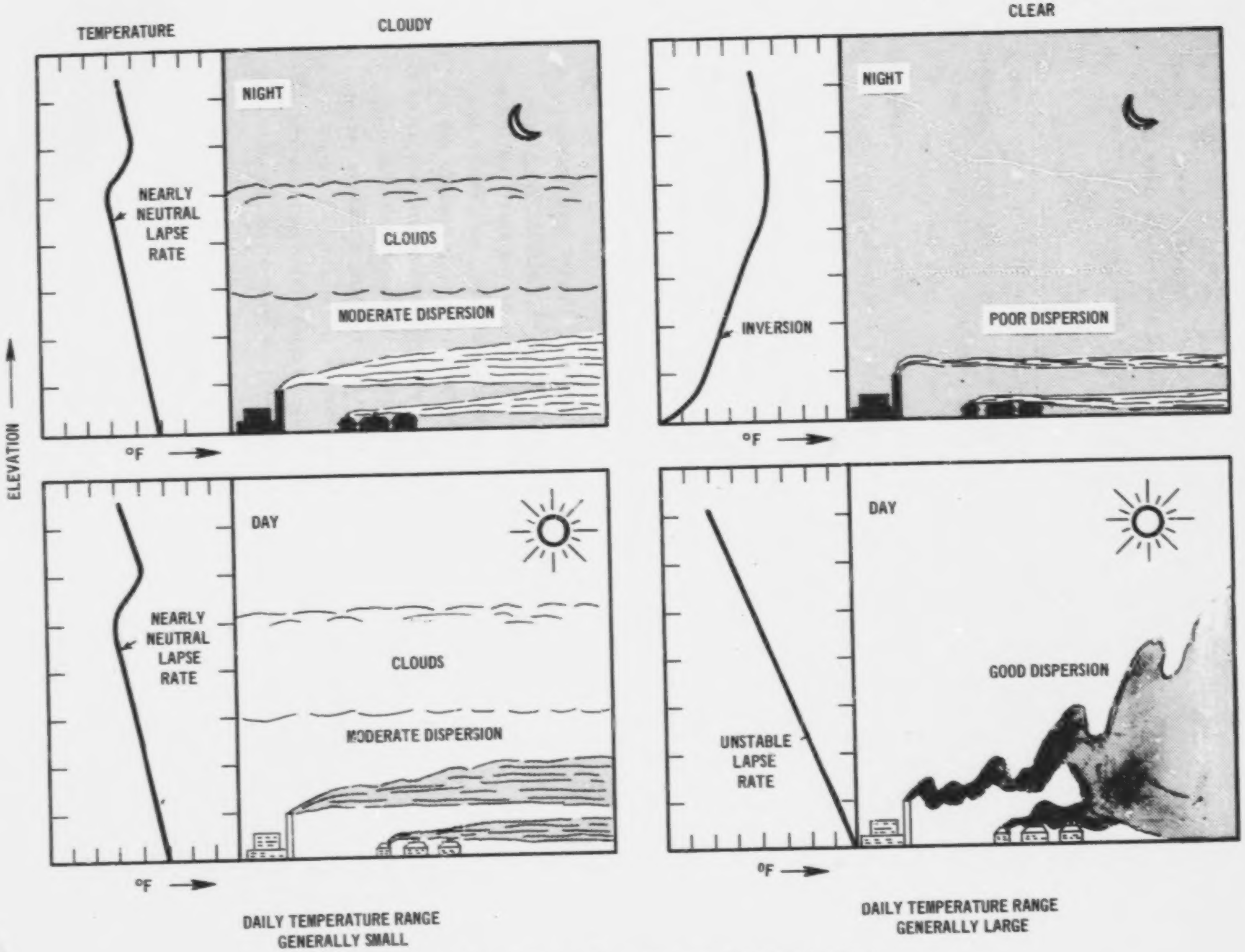

TEMPERATURE
CLOUDY
CLEAR
NIGHT
NEARLY NEUTRAL LAPSE RATE
CLOUDS
MODERATE DISPERSION
INVERSION
POOR DISPERSION
ELEVATION
°F
DAY
UNSTABLE LAPSE RATE
GOOD DISPERSION
DAILY TEMPERATURE RANGE GENERALLY SMALL
DAILY TEMPERATURE RANGE GENERALLY LARGE

Figure 1.2. DIURNAL VARIATION OF VERTICAL MIXING.

noted that contaminants released during stable conditions at the surface are not transported aloft; conversely, contaminants released aloft from tall chimneys, etc., are not generally transported to the ground under these conditions.

With the coming of daylight, the ground begins to heat and the inversion is gradually destroyed. This may result in "fumigation," the rapid mixing downwards of contaminants which were released aloft during the night. This condition often leads to high concentrations during the early forenoon, before the vigorous mixing of fully developed turbulence re-establishes itself to complete the daily cycle. This cycle may be broken or modified by the presence of clouds or precipitation, which serves to inhibit the vigorous convection of the daytime, but also may prevent the formation of strong inversions during the night.

In urban areas where pollution is most likely, the typical lapse rate regime of the open countryside is modified, particularly at night. Industrial processes, increased heat capacity of urban areas and roughness of the buildings contribute to thermal and mechanical turbulence, and the enhanced mixing prevents the formation of a surface inversion. This mixed layer, usually 100-500 feet (about 30-150m) thick, is capped by an inversion whose base in open country would have been at ground level. Such a condition may neutralize the advantage of emission from tall stacks, since the pollutants emitted will be confined within this relatively shallow layer.

D. Trajectory Analyses

In most discussions of air flow, it is assumed for convenience that the wind remains steady in direction and velocity over a considerable period of time and an extensive area. Actually, this is not the case and detailed analyses of wind flow must take these variations into account. Where the wind flow differs from place to place or with time, owing to pressure gradient differences or topography, meteorological trajectory analyses are extremely useful in air pollution investigations in following the action of contaminants released, or in tracing measured contaminants to their probable source. The computation of exact trajectories requires a large number of accurate wind data, but approximate trajectories can often be evaluated from only a few wind observations and still serve useful purposes.

E. Atmospheric Dispersion

Atmospheric dispersion does not remove air pollution but merely dilutes it through an increasing volume. The processes involved are very complicated and only limited knowledge is available at the present time. Because the use of a formula or technique for quantitatively evaluating atmospheric dispersion requires a detailed knowledge of the meteorological processes involved, it is strongly recommended that all such evaluations be made by a meteorologist.

Contaminants may be effectively removed from the atmosphere by gravitational settling if the particle size is sufficiently large. The smaller particles, which often constitute a large fraction of the material, may be removed by impaction on the surfaces of the earth, on vegetation or on buildings, etc. Perhaps the most efficient cleansing agent of the atmosphere is precipitation. The larger particles are readily scavenged from the atmosphere by the falling raindrops. Smaller particles, too, may be accumulated in raindrops and thus removed from the atmosphere. Some evidence exists that air pollution may itself slow precipitation-forming processes.

The gaseous contaminants released into the atmosphere will primarily be removed by absorption, particularly in the oceans and in precipitation. There may be other means of chemical combinations and subsequent removal, but these are likely to be much less important.

The character of pollutants may be modified by photochemical or chemical reactions or combinations which may accelerate (or retard) the effects of the pollutants on plants, animals or structures.

F. Visibility

Historically, one of the main objections to atmospheric pollution was the reduction of visibility due to the pall that often hung over industrial regions. This reduction of visibility is an important handicap to commercial transportation, particularly aircraft, and occasionally, in extreme conditions, to automobiles. Visibility is not, however, a reliable direct measurement of total air pollution levels, since it is reduced only by the particulate material, such as smoke and fly ash, sufficient to intercept and scatter visible light. Gaseous emissions or radioactive pollutants could conceivably cause more undesirable pollution levels without ever affecting visibility.

Fundamentally, however, the effect of lowered visibility resulting from pollution is important not because of the reduction of seeing distance but because of the reduction in the transmission of solar energy to the ground. During conditions of extreme stagnation, such as the Donora or London smog episodes, the pollution reached such high concentrations that a major decrease in solar radiation occurred. This, in turn, permitted the lower atmosphere to remain stable for longer periods, creating a "feed back" effect.

IV. AIR POLLUTION CONTROL STRATEGIES

An air pollution control strategy is a measure or combination of measures selected to reduce mass emission rates to achieve and maintain an adopted air quality standard.

Air pollution control strategies represent methods by which air pollution control can be rationally planned, taking into account the constraints, economic and social costs and the technological difficulties that may be encountered. The development of control strategies contributes to determining the air pollution control priorities and hence the legislation, organizational structures, control programs and manpower required to achieve air quality objectives. The elements of the control strategy concept include the following:

(1) The existing air quality as measured in the region and projections of future air quality based on population and economic growth.

(2) The existing emission levels of stationary and mobile sources as expressed in an emission inventory, and projected emission inventories based on population and economic growth.

(3) The ambient air quality standards to be attained for specific contaminants or classes of contaminants (e.g., sulfur oxides, particulates, carbon monoxide, hydrocarbons, photochemical oxidants and nitrogen dioxide).

(4) Demonstration of the degree of emission reduction required of point and area sources to achieve and maintain the air quality standards, or to prevent the air quality standards from being exceeded. Calculations are accomplished by means of a proportional model, diffusion model or other procedures such as the Air Quality Implementation Planning Program (IPP)(14) or Air Quality Display Model (AQDM).(15) Background conditions and emission increases resulting from projected growth in population, industrial activity, motor vehicle traffic and other factors must be taken into account. Control strategy exercises, usually part of this process, are applied to select that measure or combination of measures which achieve maximum benefit at minimum cost.

(5) Establishment of emission limitations or emission performance standards by classes of contaminant and source activity, taking into account the control technology that is available.

(6) Establishment of legally enforceable compliance schedules which set forth the dates by which all stationary and mobile sources or categories of such sources must be in compliance. Compliance schedules are negotiated by the agency with the owners or operators of individual sources.

The control strategy concept thus relates air quality objectives to the selection, implementation and scheduling of the control measures to be applied to individual sources of air pollution. The control strategy process leads to the development of emission reduction plans (compliance plans) for specific sources. These plans provide the compliance objectives that must be fulfilled by the owners and operators of the sources of air pollution. Assurance that compliance is achieved by specified dates, and thereafter maintained, is the responsibility of the enforcement program of the air pollution control agency.

V. LEGAL AUTHORITY AND RULES AND REGULATIONS

Effective control of air pollution emission sources requires adequate legal authority under which enforcement and abatement actions can be effected. This legal authority derives from the police powers delegated to the states by the U.S. Constitution and the specialized application of accepted principles of administrative law. The legal authority may be divided into two major parts, state enabling legislation and the rules and regulations of the individual air pollution control agencies within any state.(16)

A. State Enabling Legislation

Sound enabling legislation at the state level is an essential prerequisite in establishing the legal and administrative framework necessary to organize, staff and fund agencies, provide procedures for the passage of rules and regulations as they may be required and to authorize enforcement actions. Imperfections in any enabling provision may cause delays and even failures in implementing air pollution control programs. Some essential provisions include:

(1) A comprehensive policy of air resource management intended to attain and protect acceptable air quality in all areas of the state.(17)

(2) Adequate authority to adopt rules and regulations for all sources of concern.

(3) Adequate authority to obtain pertinent source data and information and require periodic reporting of emission information.

(4) Authority to make emission reports and information available for public inspection.

(5) Authority to enter and inspect the premises of emission sources and to conduct and/or require the conduct of emission tests.

(6) Authority to prevent construction or modification of sources in accordance with emission and air quality requirements.

(7) Authority to compel compliance with rules and regulations supported by civil or criminal penalties.

(8) Provisions for injunctive relief where deemed necessary.

(9) Authority to implement emergency episode actions.

B. Rules and Regulations

Regulations which specifically limit emissions of pollutants to the atmosphere are the heart of air pollution programs. The nature and extent of emission control regulations are determined by the desired air quality and the types and sizes of emission sources in the area.

The preparation and application of emission regulations requires extensive technical knowledge about source operations and conditions. This is especially critical in documenting source violations by the field enforcement staff for the purpose of legal actions. Inadequate understanding in concepts and applications can result in the loss of critical court decisions, thus weakening the entire enforcement operation.

Rules and regulations are generally comprised of the following:

(1) Emission Limitations

These prohibit the rate of emission in excess of specified standards and include: (a) stack concentration standards tested on the basis of weight or volume of emitted pollutant per unit weight of the carrier gas or per unit of process quantity or rate (process weight); (b) visible emissions evaluated on the basis of visual observation, e.g., Ringelmann or opacity standards; (c) plant boundary or downwind concentration limits; and (d) public nuisance prohibition. (Odor nuisances may be based on measurement of odor units.)

(2) Equipment Design Standards

These are a class of regulations which specify permissible features, specifications or standards relating to the design of equipment or the prescribed use of certain control equipment. Such standards apply, for example, to multiple chamber incinerators, fuel-burning equipment, fume burner requirements for residence time and temperature, and requirements for floating roof tanks and vapor recovery systems for petroleum product storage and transfer. Regulations concerning minimum stack height may also fall under this category.

(3) Prohibition of Use of Equipment or Operation

This type of regulation prohibits the use of certain equipment, or the conduct of certain operations such as single chamber incinerators, beehive coking ovens, hand-fired combustion equipment, dump burning and various forms of open and agricultural burning.

(4) Regulation of Fuels and/or Raw Material Composition

These standards regulate the type of fuel, fuel properties, fuel preparation, fuel grades, fuel handling, fuel supply and use, fuel treatment, the use of standby fuels and fuel substitution. Most regulations of this type are directed at limiting the sulfur, ash and volatile content of fuels. (See Chapter 6, Section II, Fuel-Burning Equipment.)

(5) Emergencies

This is a special type of regulation which enables the control agency to prepare and use contingency plans in the event of a potential or an actual air pollution emergency. The elements of such regulations generally include (a) establishing emergency air quality standards, generally at several levels of severity, the attainment or immediate likelihood of which calls for emergency powers to be exercised, (b) the joint preparation by the agency and industry of emergency curtailment or shutdown plans to take effect under stipulated conditions or upon recommendation of emergency advisory bodies, and (c) in some cases the installation of emergency communication equipment connecting the air pollution control agency and selected industries.

(6) Powers

These are a group of supporting rules and regulations enacted to establish right of entry, police powers, requirements for the submission of information on pollutant emissions, access to facilities for source testing and prohibition of circumvention or evasion of other regulations.

Most of these regulations embody an explicit or implicit emission limit or design parameter which relates to a quantifiable emission limit.

The type of standard and the emission limit adopted are based on control strategies and agency policies. These dictate whether the standards are to be performance oriented, industry oriented, equipment and fuel oriented, or some combination of these. Recommended standards attainable by current technology are shown in Table 1.2.(18)

The emission limit adopted may be derived by several or a combination of methods: (a) derivation from air quality standards, using dispersion models, (b) derivation from rollback and distance proportional techniques, based on the reduction in

Table 1.2. EMISSION LIMITS ATTAINABLE BY AVAILABLE TECHNOLOGY

Type of Emissions	Source	Limits Attainable
Visible emissions	Industrial stacks	Less than No. 1 Ringelmann or 20 percent opacity except for periods up to 3 minutes in any 60 minute period.
	Gasoline powered motor vehicles	No visible emissions except for periods up to 5 seconds.
	Diesel powered motor vehicles	No. 1 Ringelmann or 20 percent opacity except for periods up to 5 seconds.
Particulate matter	Incinerators	0.1 pounds per 100 pounds of refuse charged.
	Fuel burning equipment (solid fuel)	0.1 pounds per million Btu.
	Process industries	Emission rate, E, in pounds per hour, given in terms of process. Weight rate P, in pounds per hour, is $E = 3.59\ P^{0.62}$ if P is 60,000 or less; $E = 17.31\ P^{0.16}$ if P is more than 60,000.
Sulfur oxides	Fuel combustion (Solid fuel)	1.2 pounds SO_2 per million Btu.
	(Liquid fuel)	0.8 pounds SO_2 per million Btu.
	Sulfuric acid plants	6.5 pounds per ton of 100 percent acid produced.
	Sulfur recovery plants	0.01 pound SO_2 per pound of sulfur processed.

Table 1.2. EMISSION LIMITS ATTAINABLE BY AVAILABLE TECHNOLOGY (continued)

Type of Emissions	Source	Limits Attainable
Sulfur oxides (continued)	Non-ferrous smelters	
	Copper	$Y = 0.2\ X$
	Zinc	$Y = 0.564\ X^{0.85}$
	Lead	$Y = 0.98\ X^{0.77}$
		where X is total sulfur fed to the smelter and Y is sulfur dioxide emissions, both in pound per hour.
	Sulfite pulp mills (certain sources)	9 pounds per air-dried ton of pulp produced (with new recovery systems) 20 pounds per air-dried ton (with existing recovery systems).
	Refinery process gas streams	Equivalent to 10 grains of hydrogen sulfide per 100 standard cubic feet of gas.
Total reduced sulfur	Kraft pulp mills (recovery furnace)	0.1 pounds TRS per air-dried ton of unbleached pulp (new recovery furnace)
		0.5 pounds TRS per air-dried ton of unbleached pulp (existing recovery furnace).
Oxides of nitrogen	Fuel-burning equipment (gas-fired)	0.2 pounds (calculated as NO_2) per million Btu.
	Fuel-burning equipment (oil-fired)	0.3 pounds (calculated as NO_2) per million Btu.
	Nitric acid manufacture	5.5 pounds (calculated as NO_2) per ton of 100 percent acid produced.

(SOURCE: BASED ON FEDERAL REGISTER, Reference 18) per unit of source necessary to roll back the future pollutant level to known or presumed pollutant levels in the past, (c) derivation from process and equipment considerations, considering the performance of a range of the best constructed and operated plant, or the best state-of-the-art technology available.(19) A rational and realistic approach is one which takes all of these factors into account. Control strategy exercises play an important role in this process.

VI. THE AIR POLLUTION CONTROL AGENCY

A. Objectives

The basic objective of air pollution control programs is to protect the health and welfare of man from the harmful effects of air pollution. Other objectives include the protection of plant and animal life, protection of property and prevention of interference with the normal use, enjoyment and safety of our air resources.

Until recently, local air pollution control programs were oriented along two major lines: (1) control of smoke and particulates from combustion sources and (2) control of emissions that were deemed a "nuisance" by virtue of citizens' complaints. Significant progress was made in the late 1930's and 1940's in the reduction of smoke from the combustion of high content matter bituminous coal. These reductions were made by regulating fuel quality and fuel use.

The air pollution problems of today and the future are concerned with the complexities of the emissions from more exotic sources, new and rapidly expanding technology and larger unit operations. All of these factors are compounded by the achievements of higher standards of living, consumption of ever increasing goods and energy and the demand for a healthier environment.

This challenge requires a new and highly intensified approach in the prevention, control and management of all factors contributing to air pollution problems. The major elements(17) in carrying out such programs include:

(1) Development of a public policy for the improvement and preservation of air quality.

(2) An organizational framework and staff capable of operating along functional lines (e.g., engineering, technical services, field services) supported by adequate funding.

(3) Delineation of realistic long and short range goals that can be effectively met in reasonable time periods. This can be presented as an implementation plan calculated to achieve desired air quality.

(4) Continual assessment of existing air quality and preparation of estimates of future conditions.

(5) Continual assessment of source emissions, present and future.

(6) Development of the necessary information about factors that influence the transport of air pollutants.

(7) Assessment of the effects of ambient air quality of a community or region on man and his environment.

(8) Establishment of program coordination and support with other governmental organizations such as the state attorney general's office, fire prevention bureaus, police departments and planning organizations.

(9) Development of an effective information and educational program to inform the community of the need to solve air pollution problems promptly and effectively.

The mechanisms for reaching decisions on a community (or state) level are of key importance to the success of an air resource management program. They must provide for the assimilation of information, and the establishment of goals and policies concerning the management of the community's air resource. Appropriate community involvement in the decision-making process must be encouraged to ensure a base of public support for action.

The degree of success achieved in reaching decisions and developing policy will depend upon the clear delegation of responsibility to a key individual. Full support by top management (including chief elected executives) is essential.

B. Agency Functions and Responsibilities

The organization and elements of an air pollution control program should be based on the requirements that must be satisfied to achieve air quality objectives in the given area of jurisdiction. Knowledge of the requirements arises from a thorough investigation of the nature and extent of the air pollution problem and the applicable air pollution control technology or control strategies. The organization of the air pollution control agency must reflect the following considerations:

(1) The scope or jurisdiction of the agency with respect to its responsibility for air pollution and environmental control.

(2) The types, complexities and number of air pollution sources within the area of jurisdiction.

(3) The role of the agency in planning, rule-making, enforcement, engineering, technical support services, information dissemination, research, health effects studies, interjurisdictional coordination and other functions.

(4) The level of government at which the agency operates: local (municipal, county, city-county), regional, state, interstate and federal.

(5) The authority of the agency to adopt and enforce regulations and measures necessary for the attainment and maintenance of air quality and emission standards.

(6) Work functions or tasks within each program element including such activities as air monitoring, facility inspections, source registration, source testing, data handling and engineering evaluations.

(7) Division of responsibility in technical and administrative functions necessary to carry out the work to be done by the agency.

The responsibilities assumed by states, local and regional jurisdictions depend on many factors, most notably existing governmental structures and state-local relationships. In general, state agencies are assuming increasing authority and responsibility over local sources of air pollution. Municipalities and counties with large urban populations tend to have strong, comprehensive air pollution control programs. However, in accordance with the Clean Air Act, as amended in 1970, state agencies are assuming increasing responsibility and authority for air pollution control and the support and coordination of local agencies in their efforts. State agencies that are responsible for large geographic areas are in a position to develop balanced, comprehensive programs and to make efficient use of the total available resources. The intent, however, is for program activities to remain within the governmental jurisdiction that can most effectively assume the responsibility. Routine enforcement actions, for example, are usually most effectively operated at the regional, county or municipal level.

A suggested division of responsibilities (Table 1.3) can be used as a basis for developing an organizational pattern.

C. Organizational Structure

The organization of air pollution control agencies varies considerably depending on the hierarchy of the state or local government. Agencies located within health departments are generally organized as sub-unit functions served by laboratory and administrative services provided by other sub-units (e.g., Figure 1.3). Separate agencies such as Departments of Air and Water Programs are generally organized as self-

Table 1.3. TYPICAL DIVISION OF RESPONSIBILITIES BETWEEN STATE AND LOCAL AIR POLLUTION CONTROL AGENCIES

STATE AGENCY	LOCAL AGENCY
- Possesses legal authority to implement a plan for attainment of air quality objectives.	- Possesses legal authority necessary to implement any portion of the state control plan.
- Prepares statewide standards and regulations.	- Adopts standards and regulations consistent with, or more stringent than, those of the state.
- Prepares emergency episode action procedures.	- Enforces state approved emergency procedures within local jurisdiction.
- Assigns responsibilities to other governmental agencies (e.g., fire, police, and planning departments) to carry out portions of the control plan.	- Develops cooperative agreements with other local government agencies to carry out control responsibilities.
- Enforces statewide standards and regulations.	- Enforces appropriate state or local regulations.
- Institutes legal action where local action is deficient or unauthorized; - Provides legal assistance to local agencies where necessary to support local enforcement action.	- Initiates legal action to support enforcement and abatement needs.
- Develops a statewide program for source compliance.	- Develops compliance schedules with local sources in accordance with state policy and procedures.
- Defines compliance schedule policy and monitors for adequate implementation.	- Monitors local sources for progress in achieving compliance.
- Develops and implements a statewide permit system of operation.	- Assists the state in the operation of the permit system.
- Develops and maintains a statewide emission inventory.	- Provides local source emission data.
- Coordinates statewide complaint handling activities.	- Provides local complaint handling service.

Table 1.3. TYPICAL DIVISION OF RESPONSIBILITIES BETWEEN STATE AND LOCAL AIR POLLUTION CONTROL AGENCIES (continued)

STATE AGENCY	LOCAL AGENCY
- Operates a statewide air surveillance system.	- Operates a local air surveillance system in accordance with the state plan.
- Provides statewide laboratory services.	- Provides local laboratory services to the extent authorized by state agency.
- Assures consistency of all analytical and calibration procedures in state and local laboratories.	
- Conducts source testing on a statewide basis.	- Provides assistance to state source test efforts.
- Prepares statewide diffusion climatologies and meteorological summaries.	- Collects and analyzes meteorological data in accordance with state and local needs.
- Provides meteorological consultation.	
- Develops and maintains statewide data handling system which facilitates the retrieval of pertinent data for all program operations.	- Operates local data handling system compatible with state system.

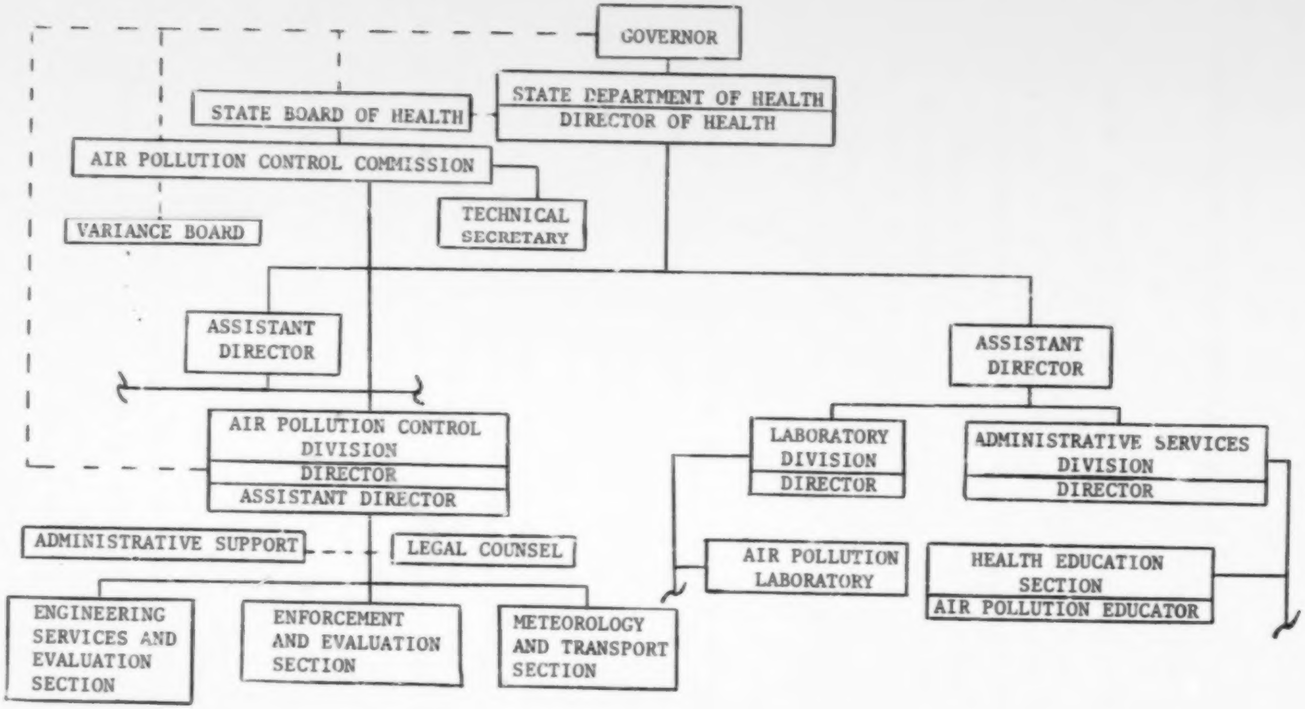

GOVERNOR
STATE DEPARTMENT OF HEALTH
DIRECTOR OF HEALTH
STATE BOARD OF HEALTH
AIR POLLUTION CONTROL COMMISSION
TECHNICAL SECRETARY
VARIANCE BOARD
ASSISTANT DIRECTOR
ASSISTANT DIRECTOR
AIR POLLUTION CONTROL DIVISION
DIRECTOR
ASSISTANT DIRECTOR
LABORATORY DIVISION
DIRECTOR
ADMINISTRATIVE SERVICES DIVISION
DIRECTOR
ADMINISTRATIVE SUPPORT
LEGAL COUNSEL
AIR POLLUTION LABORATORY
HEALTH EDUCATION SECTION
AIR POLLUTION EDUCATOR
ENGINEERING SERVICES AND EVALUATION SECTION
ENFORCEMENT AND EVALUATION SECTION
METEOROLOGY AND TRANSPORT SECTION

Figure 1.3. ORGANIZATIONAL STRUCTURE OF COLORADO DIVISION OF AIR POLLUTION CONTROL (JANUARY 1970)

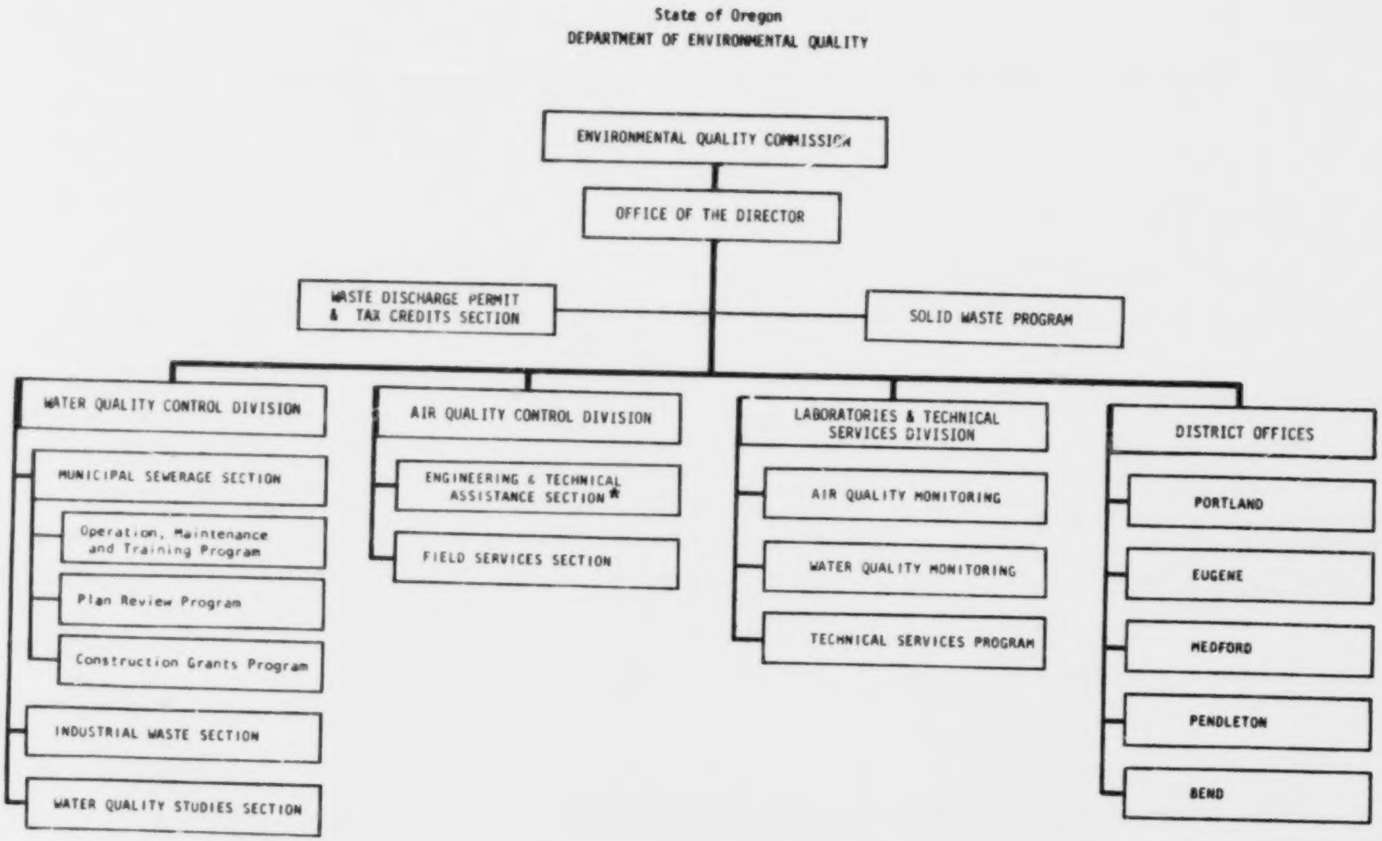
supporting entities with functional responsibilities aligned within the program (e.g., Figure 1.4).

In theory, the organizational configuration of the agency has minimal influence on the effectiveness of the operation. In practice, however, a significant number of functional weaknesses can be traced to poor organizational structure which are frequently compounded by poorly defined responsibilities. An effective control agency needs: (1) capable and competent staff, (2) a clearly defined organization aligned with functional responsibilities, (3) clearly defined lines of authority and (4) adequate support. Figure 1.5 is a suggested organization that best satisfies these requirements for effective operations.

All state agencies in accordance with the responsibilities outlined in the Clean Air Act, as amended in 1970, would have comprehensive responsibilities for the prevention and control of air pollutant emissions. The organization and functional responsibilities of local agencies will vary depending on their role in the state's total control plan. In the larger urban areas, the local control agency will generally assume comprehensive responsibility (see Figure 1.6) similar to the state agency. At the other end of the scale, minimal agencies will assume responsibility for specified field surveillance, inspection and enforcement activities. The organization should reflect the functional responsibility. In all instances the state agency must fill all program voids in addition to prescribing guidance, leadership and coordination to the local agencies.

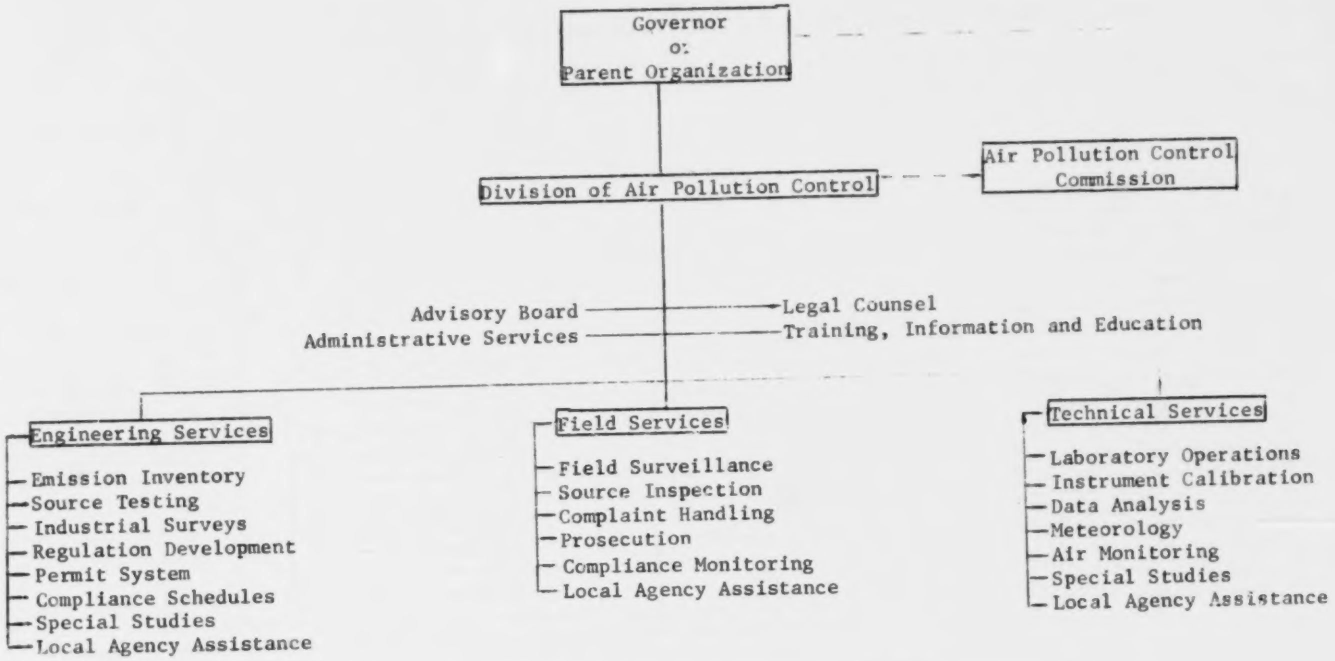
D. Staffing Patterns

The scope and organization of an air pollution control agency is customarily expressed in terms of manpower and functional staffing


State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL QUALITY COMMISSION
OFFICE OF THE DIRECTOR
WASTE DISCHARGE PERMIT & TAX CREDITS SECTION
SOLID WASTE PROGRAM
WATER QUALITY CONTROL DIVISION
MUNICIPAL SEWERAGE SECTION
Operation, Maintenance and Training Program
Plan Review Program
Construction Grants Program
INDUSTRIAL WASTE SECTION
WATER QUALITY STUDIES SECTION
AIR QUALITY CONTROL DIVISION
ENGINEERING & TECHNICAL ASSISTANCE SECTION*
FIELD SERVICES SECTION
LABORATORIES & TECHNICAL SERVICES DIVISION
AIR QUALITY MONITORING
WATER QUALITY MONITORING
TECHNICAL SERVICES PROGRAM
DISTRICT OFFICES
PORTLAND
EUGENE
MEDFORD
PENDLETON
BEND

* Includes enforcement activities.

Figure 1.4. DEPARTMENT OF ENVIRONMENTAL QUALITY, STATE OF OREGON (JANUARY 1971)


Governor
or
Parent Organization
Division of Air Pollution Control
Air Pollution Control Commission
Advisory Board
Administrative Services
Legal Counsel
Training, Information and Education
Engineering Services
Emission Inventory
Source Testing
Industrial Surveys
Regulation Development
Permit System
Compliance Schedules
Special Studies
Local Agency Assistance
Field Services
Field Surveillance
Source Inspection
Complaint Handling
Prosecution
Compliance Monitoring
Local Agency Assistance
Technical Services
Laboratory Operations
Instrument Calibration
Data Analysis
Meteorology
Air Monitoring
Special Studies
Local Agency Assistance

Note: Local agency assistance and coordination may be elevated to a fourth program unit if warranted.

Figure 1.5. SUGGESTED ORGANIZATIONAL STRUCTURE OF AN AIR POLLUTION CONTROL AGENCY.

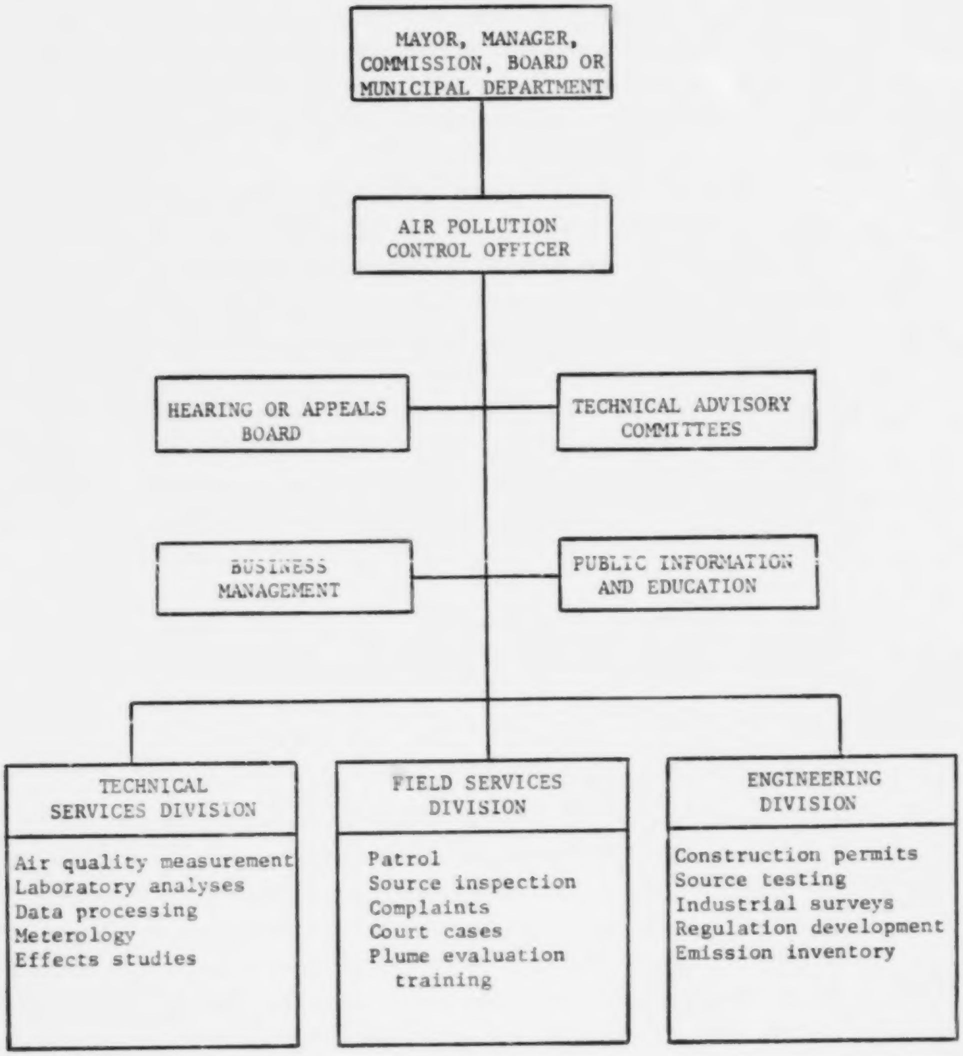

MAYOR, MANAGER, COMMISSION, BOARD OR MUNICIPAL DEPARTMENT
AIR POLLUTION CONTROL OFFICER
HEARING OR APPEALS BOARD
TECHNICAL ADVISORY COMMITTEES
BUSINESS MANAGEMENT
PUBLIC INFORMATION AND EDUCATION
TECHNICAL SERVICES DIVISION
Air quality measurement
Laboratory analyses
Data processing
Meterology
Effects studies
FIELD SERVICES DIVISION
Patrol
Source inspection
Complaints
Court cases
Plume evaluation training
ENGINEERING DIVISION
Construction permits
Source testing
Industrial surveys
Regulation development
Emission inventory

Figure 1.6. TYPICAL ORGANIZATION CHART FOR A LOCAL GOVERNMENTAL AIR POLLUTION CONTROL AGENCY

(SOURCE: SCHUENEMAN, Reference 17)

(staffing to perform prescribed tasks). A systematic approach to agency development quantitatively relates staffing to the expected work required to achieve reductions in emission rates necessary to meet air quality objectives within prescribed periods of time.

In the initial stages of program development, control agency management must establish a priority system of operation as a part of its program planning. As funds and positions are made available, competent staff members must be selected who possess the specific skills that will contribute to satisfying these priorities.(20) Early priorities will likely include data gathering activities, which will require the establishment of an air quality monitoring program, and assembling information on the sources of pollution in order to assess their contribution to air quality and to prepare reasonable compliance schedules. Field operations are then implemented to monitor compliance and to develop effective control and enforcement procedures.

Table 1.4 summarizes functions associated with air pollution control programs. Each function or group of functions requires a specific category of skills.

E. Intergovernmental Relationships

The complexities of air pollution problems necessarily involve many governmental agencies, frequently at different levels of operation. For example, the operation of a permit system may require the participation of a department of public works. Construction of a new facility capable of emitting air contaminants is of interest to zoning and planning organizations. The use of wet collection devices is of concern to water pollution and solid waste control agencies. The issuance of an open burning permit requires the attention of the fire department. Many control agency activities, therefore, must interface

Table 1.4. SUMMARY OF FUNCTIONS FOR AIR POLLUTION CONTROL PROGRAMS

1. Management Services

   a. Policy
   b. Administration and fiscal management
   c. Public information and education
   d. Intergovernmental liaison
   e. Legal counsel
   f. Staff training and development
   g. Program planning and evaluation
   h. Clerical support

2. Field Enforcement Services

   a. Inspections and compliance monitoring
   b. Complaint handling
   c. Field surveillance
   d. Preparation for legal actions
   e. Implementation emergency episode procedures
   f. Source identification and registration
   g. Clerical support

3. Engineering Services

   a. Emission inventory
   b. Permit system and compliance scheduling
   c. Source testing
   d. Technical development of control regulations
   e. Preparation of technical reports, guides and criteria on control
   f. Design and review of industrial emergency episode procedures
   g. Clerical support

4. Technical Services

   a. Laboratory operations
   b. Operation of monitoring network
   c. Data acquisition, processing and reporting
   d. Special field studies
   e. Instrument maintenance and calibration
   f. Clerical support

with one or more external agencies. This interface may extend to governmental agencies above or below the agency initiating the action. For example, a regional air pollution control agency may require involvement of a state water pollution control commission in decisions regarding scrubber effluent discharges.

As cooperative program activities are established it is important that a clear understanding of responsibilities and operating procedures be established. A protocol document or memorandum of agreement serves as an excellent means of providing clear understanding for such joint relationships. Written agreements in field operations should be generated with such agencies as public works, fire and police departments. The contents of such documents should be reviewed periodically for the purpose of upgrading working relationships and eliminating obsolete arrangements.

VII. THE FIELD ENFORCEMENT OFFICER

Field enforcement personnel assume that portion of the control agency function which is directly responsible for the implementation of control strategies designed to achieve desired air quality levels. They constitute the primary field operations arm of the air pollution control agency.

A. Scope of the Field Operations Program

The major external determinants of the field operations program are the types and numbers of stationary sources that require inspection, as determined from source registration and the emission inventory (See Chapter 2, The Enforcement Process). The major internal determinants are the number and types of rules and regulations that must be enforced, the source registration support required, permit and certification systems support and the operating policies and problems of the agency. Field personnel also must deal with motivations, needs and problems of individuals and with other environmental, economic, legal and social considerations that are encountered in the field.

Enforcement activities fall into four categories: (1) field surveillance and patrol, (2) engineering and source inspections, (3) general investigations and complaint handling and (4) administrative, supervisory, clerical and other support functions. Smaller agencies may combine the functions of field inspectors, engineering inspectors and case investigators. Agencies concerned with an extensive and diversified stationary source population will have larger and more varied work loads, and will require a greater degree of specialization in the work force.

B. The Field Enforcement Officer

The background and degree of special training required of field enforcement personnel depend on the major responsibilities to be assigned to a particular individual. The scope of these responsibilities are influenced by the size of the agency, the number and types of sources to be observed and inspected and the availability of support services. The smaller agencies, by necessity, combine field enforcement functions and usually rely on assistance from other related governmental agencies or organizations.

The field enforcement officer(21) is in a position of constantly meeting people, solving problems, obtaining information, conducting investigations and issuing violation notices. An unusual person is required to handle such varied duties with skill and diplomacy. Accordingly, a field enforcement officer should possess:

(1) A mature personality capable of dealing with the public in an efficient, business-like manner, often under strained conditions.

(2) Ability to gather facts and information and organize such material in a concise and informative manner.

(3) Sufficient background and training in the physical sciences and the ability to communicate in the field of air pollution and source technology.

(4) Potential in legal enforcement and ability to provide court testimony.

(5) Ability to function as an effective member of an air pollution control team.

These requirements relate to skills and aptitudes and may, in many cases, be independent of experience and education. They can be determined, to some extent, by aptitude test and job screening. Some of the skills, given basic aptitudes, can be further developed through on-the-job training. Some specific capabilities that are particularly important in enforcement are:

(1) High general intelligence (arithmetical and verbal)

(2) Ability to comprehend engineering and legal information

(3) Objectivity, judgment and emotional stability

(4) Motivation

(5) Approach and appearance

(6) Ethics and sense of responsibility.

Field enforcement officers must be able to comprehend the law and to relate code sections or rules to corresponding problems encountered in the field. They should be able to discriminate from the facts gathered in the field among flagrant, chronic, borderline or accidental violations and to recognize sincerity and motivation on the part of plant operators. They must be able to analyze situations for the objective facts and be able to enforce the law equally and firmly.

The ability of the field enforcement officer to express himself completely and accurately, orally and in writing, is important since his findings are always being reported for proper action. Particularly is this important when an enforcement officer testifies in court or explains a law or policy to a plant operator.

The greater the technical background of enforcement officers, the more the field operations program will be able to probe field problems. The technical background that will be required will vary according to the responsibilities assigned. Enforcement officers should have or be able to acquire a basic knowledge of combustion processes and equipment operation. They should be able to identify and classify equipment and processes for source registration and emission inventory purposes, and to determine the causes of air pollution problems. The enforcement officer may be required to correlate such data as excessive pouring temperatures, alloys, fluxes used and relative volatilities of metals with the opacities or densities of emissions he observes. Enforcement officers specializing in complex industries will generally require greater technical background in chemistry, chemical engineering or mechanical engineering.

C. Training

Training of field enforcement officers is an essential part of the field operations program. It currently plays an indispensable function in certain enforcement functions, such as the certification of field enforcement officers as expert smoke readers, preparation of enforcement officers as court witnesses, orientation to industrial processes and control technology and on-the-job field training.(22) In addition, a number of different types of courses are available at the state level, Office of Manpower Development, Environmental Protection Agency and a number of universities. Such courses serve the important purpose of transmitting ever-expanding information on environmental control technology to where it is most needed--in the field.

The training of field enforcement officers, however, is an area of professional development that has been largely overlooked. The field enforcement officer has been isolated in the field and isolated from other professionals working in air pollution and environmental control. This situation tends to result in the absence of communication of enforcement technique and experience among air pollution control agencies which is necessary to the evolutionary development of the state-of-the-art. This condition is illustrated by the paucity of published information available on enforcement technique as compared to other facets of air pollution control.

Training of field enforcement officers in the future, therefore, should include training which is conducted by the field enforcement officers themselves in the form of seminars and conferences which will permit the exchange of information on enforcement and the development of future curricula and areas of investigation.

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CHAPTER 2
THE ENFORCEMENT PROCESS

I. INTRODUCTION

The responsibility for reducing or curtailing air pollution falls on the enforcement branch of the air pollution control agency. This mission can only be accomplished by means of direct and frequent contact with the owners and operators of the sources of air pollution in order to ensure the widespread use of the best of the available control technology. Enforcement of the rules and regulations is the primary mechanism for achieving this goal. Both the standards contained in the rules and regulations and the procedures used in their enforcement, therefore, should be clear and certain from the standpoint of both voluntary and compulsory compliance.

II. OVERVIEW OF THE ENFORCEMENT PROCESS

Many administrative, legal and technical factors must be considered in attempting to achieve mass compliance on a large scale at the earliest possible time. To help visualize the interrelationships of these factors, Figure 2.1 presents an overall view of the functional elements of the enforcement process and identifies variations in practices among a number of major air pollution control agencies.

A. Field Operations

Field operations (top center of Figure 2.1) initiate the enforcement process by establishing whether or not individual emission sources comply with the rules and regulations. To meet this objective, enforcement personnel perform the following functions:

- Notification. Apprise all affected owners and operators of compliance requirements.
- Surveillance. Detect, observe and identify all emission sources.

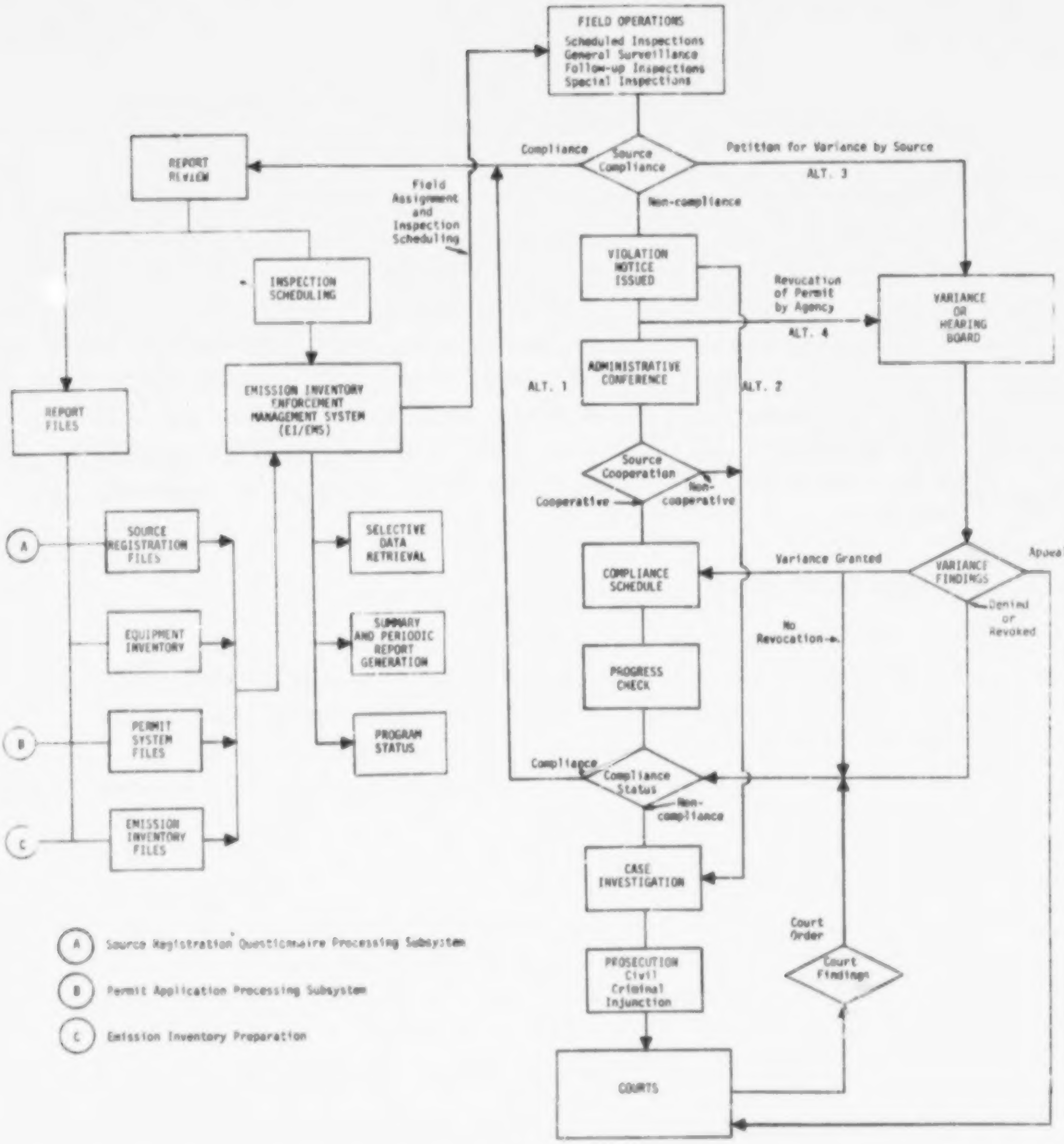
FIELD OPERATIONS
Scheduled Inspections
General Surveillance
Follow-up Inspections
Special Inspections
REPORT REVIEW
Compliance
Source Compliance
Petition for Variance by Source
ALT. 3
Non-compliance
Field Assignment and Inspection Scheduling
INSPECTION SCHEDULING
VIOLATION NOTICE ISSUED
Revocation of Permit by Agency
ALT. 4
VARIANCE OR HEARING BOARD
EMISSION INVENTORY ENFORCEMENT MANAGEMENT SYSTEM (EI/EMS)
REPORT FILES
ALT. 1
ADMINISTRATIVE CONFERENCE
ALT. 2
Source Cooperation
Cooperative
Non-cooperative
A
SOURCE REGISTRATION FILES
SELECTIVE DATA RETRIEVAL
EQUIPMENT INVENTORY
SUMMARY AND PERIODIC REPORT GENERATION
COMPLIANCE SCHEDULE
Variance Granted
VARIANCE FINDINGS
Appeals
Denied or Revoked
No Revocation
PROGRESS CHECK
B
PERMIT SYSTEM FILES
PROGRAM STATUS
C
EMISSION INVENTORY FILES
Compliance
Compliance Status
Non-compliance
CASE INVESTIGATION
Court Order
Court Findings
PROSECUTION Civil Criminal Injunction
COURTS
A Source Registration Questionnaire Processing Subsystem
B Permit Application Processing Subsystem
C Emission Inventory Preparation

Figure 2.1. OVERVIEW OF THE ENFORCEMENT PROCESS. ALTERNATIVE 1: ADMINISTRATIVE CONFERENCE; ALTERNATIVE 2: NOTICE-TO-COURTS; ALTERNATIVE 3: PETITION FOR VARIANCE BY SOURCE; ALTERNATIVE 4: REVOCATION OF PERMIT.

- Inspection. Enter facilities and inspect all emission sources to determine compliance and gather information pertinent to factors causing emissions, conduct necessary emission and other tests, collect evidence, issue violation notices or citations and promote voluntary compliance.

The term "compliance" means that a source does not violate any rule and regulation. At least 3 statuses of compliance should be distinguished:

- Continuing Compliance--the realization of a source emission reduction plan or emission limit requirements on a continuing, long-term basis. Continuing compliance implies confidence that the facility is operating with little or no risk of violation and requires minimal surveillance.

- Functional Compliance--the status of a facility only at the time it is observed or inspected by a field enforcement officer. A facility is in technical compliance whenever insufficient information or evidence is available to justify serving a violation notice or citation even though non-compliance may be suspected. This includes situations where source testing or special investigations may be required to make a definitive compliance determination.

- Non-Compliance--any violation of a rule or regulation supported by valid information and evidence and justifying the issuance of a violation notice or citation.

Thus, any individual observation or inspection of an emission source, as shown in Figure 2.1, results in 1 of 2 determinations: (1) compliance, (2) non-compliance (violation). These necessitate two distinct processing procedures. Reports of compliance (both continuing and functional) are reviewed, processed and rescheduled for inspection. Functional compliance cases, particularly those where violations are suspected, are assigned higher surveillance and inspection frequencies, or require special follow-up action, such as source testing. Where non-compliance is established, violation notices are issued, reviewed and processed towards legal action until continuing compliance is achieved.

The handling of functional compliance cases is the greatest problem facing enforcement personnel. While violations of visible emission standards and permit infractions are relatively easy to demonstrate, violations due to grain loading, process weight, fuel composition or standards regulating gaseous contaminants are more difficult and require special handling. Compliance determinations in these cases are made after sufficient information is gathered by the field enforcement officer on the design, operation and maintenance of the equipment. This is accomplished by gathering information on the inspection points appropriate to each class of source, as described in the inspection points sections of Chapters 5, 6 and 7. The information collected may establish the requirement for fuel and material sampling, review of facility plans and operational data, and the performance of special emission source tests or ambient air monitoring. The enforcement officer should recommend appropriate sampling methods in order to obtain data that show whether or not the emission source is in continuing compliance through all ranges of its operation.

B. Enforcement Actions

Enforcement action is indicated whenever a notice of violation or citation has been issued or whenever a report has been written that establishes all of the facts and evidence necessary to prove the occurrence of a violation of the rules and regulations. The objective of enforcement is to bring all sources which are in violation into a continuing compliance status as soon as possible.

Common variations in the processing of violation notices and reports among a number of air pollution control agencies are shown in the vertical information flow down the center of Figure 2.1. Even within one agency, alternative paths to compliance short of, and/or including, legal action may be provided for. These will depend on the history of the agency, the powers delegated to it, the stage of its development and its administrative skills.

Alternative 1. Administrative Conferences and Hearings.

The owner or operator of a facility in violation is requested to attend an administrative conference or hearing, usually at control agency headquarters. Informal or preliminary hearings are presided over by enforcement agency staff members. Formal hearings may be presided over by the air pollution control officer, a hearing master or hearing board. The owner may cooperate by agreeing to correct the problem or to prepare a compliance plan or schedule. The facility is periodically inspected by field enforcement officers to establish if the problem has been corrected according to schedule. If repeated violations occur, the case may be prosecuted in the courts. Administrative conferences may also be conducted at the facility. (See Administrative Hearing Process, Section II, Chapter 3.)

Alternative 2. Notice-to-Courts Route.

In this procedure, the preparation of a written notice automatically leads to the preparation of a misdemeanor complaint and prosecution in the courts. Investigation is generally conducted to confirm field evidence and source ownership and responsibility. (See Section III, Hearing Boards, and Section IV, Courts, Chapter 3.)

Alternative 3. Variance.

This alternative is a procedure which is initiated by a facility which has knowledge of compliance requirements and wishes to obtain a variance from the affected rules and regulations in order to correct an air pollution problem. The owner petitions a hearing board for a variance from an affected rule or regulation to correct its emission problem. The hearing board may either grant or deny the variance. The granting of the variance usually will depend on the nature of the problem, the equities involved and the preparation of a compliance plan. Compliance with the terms of the variance is checked by the field enforcement officer.

Alternative 4. Permit Systems.

This alternative is employed by enforcement agencies that operate permit systems. Where a permit or certificate to operate equipment is granted, but the equipment is found later to repeatedly violate the rules and regulations, the air pollution control agency may petition the hearing board to revoke the permit. Similarly, the owner of the equipment may petition a hearing board, with cause, if an agency denies a permit application.

The compliance path that should be used depends on the nature of the violation. Some violations may be due to negligence and are easily corrected through improved equipment operation or maintenance. Others may be due to difficult engineering problems which may be costly and difficult to correct. In the latter case, some form of negotiated compliance plan should be prepared by the owner of the equipment and evaluated by the control agency.

The compliance plan thus may be the result of an administrative conference, a hearing board action or a court action. The procedure selected should be one which provides for decisiveness and speed in reaching the desired compliance. Care must be taken, however, in adopting enforcement procedures which, because of appeals and court reversals, ultimately diminish the legal authority of the agency. The legal history and precedents established by an air pollution control agency are as much an integral part of the legal authority as the written laws which it enforces.

C. Relationship to Other Control Functions

The enforcement activity is interrelated with certain information gathering, planning and regulatory functions carried on by other branches of the air pollution control agency, such as engineering, technical and administrative services. The principal elements of concern to the enforcement function are shown as data gathering and processing subsystems on the left side of Figure 2.1. These include the following:

(1) Source Registration. Source registration is the process of gathering, usually for the first time, data on the name, location, nature of business, ownership, number of employees, fuel use, refuse disposal practices and other information from all industrial, commercial and governmental facilities that conduct activities that cause the emission of air contaminants. It is conducted for the purpose of identifying,

locating and assessing the stationary source emission problems of an area. The information is usually gathered by means of a questionnaire sent to industrial and commercial establishments and is verified, updated or supplemented by field inspection reports, as shown in Figure 2.1. The equipment inventory procedure, described in Section IV B, is, in effect, a source registration process performed by field enforcement personnel.(1)

(2) Emission Inventory. The emission inventory is a process whereby available data on source activity and source tests are collected and evaluated to quantify the emission potential of an area. The emission inventory is a tabulation of emission rates in weight units by contaminant, time interval and grid area. All significant categories of emission sources are accounted for: Moving sources (motor vehicle and other transportation sources), area sources (residential and other widely distributed sources), and stationary sources (fixed or point sources of high emission rate). The emission inventories are used to rank emission sources by the importance of their contribution to air quality and specific air pollution problems. The emissions inventory thus establishes emission reduction priorities and a basis for scheduling of field enforcement inspections and activities.

(3) Permit System or Other Plan Review or Certification Systems. These are engineering plan-review systems which regulate the construction and operation of equipment capable of emitting air contaminants. In the permit system, an applicant wishing to construct or operate new equipment capable of emitting air contaminants submits information on the design, location, performance and operation sufficient to making an engineering determination of the potential of the equipment to comply with the rules and regulations. If operation of the equipment is likely to result in compliance, the permit to construct or to operate is granted. If the equipment is not likely to comply, the permit is denied. Some agencies require authority to construct and a separate permit to operate. Other agencies limit their requirements to permits to operate. Permits are frequently separately required for basic and air pollution control equipment. The term "certificate" is sometimes used in lieu of "permit." The permit system is usually conducted by the engineering services branch of the agency. It is enforced by field enforcement officers who may also participate in approval or denial decisions.(2,3)

Depending upon the policies and programs of any given agency the above functions may be coordinated through the administration of a permit system, or by an Enforcement Management System (EMS) or

Emission/Inventory/Enforcement Management System (EI/EMS), as shown in Figure 2.1. The latter will tend to be employed where permit systems are not practiced or the permit system is not employed as the principle means of achieving source reductions.

Each of the subsystems (A), (B) and (C) shown in this figure are stand-alone systems usually operated by the engineering services branch of the agency. Pertinent field inspection reports, particularly those which have been prepared to follow-up on source registration and permit system actions, are input to these systems as required. Principal data storage and retrieval may be accomplished by an automated data processing system which maintains separate data bases from information extracted from each of the subsystems shown. The EI/EMS should have the ability to schedule field inspections, conduct selective data retrievals, conduct data analysis and to generate summary and other status reports as may be required.

The following sections of this chapter further describe the elements of the enforcement process that are of most concern to enforcement personnel.

III. FIELD SURVEILLANCE PROCEDURES

Field surveillance is a field operations activity which provides for the systematic detection and observation of emission sources in all areas of the control jurisdiction. Observations are made of whole industrial areas and the exteriors of facilities for visible emissions, odors, contaminant damage, new facility construction or expansion and other visual or sensory manifestations of air pollution.

Surveillance is conducted mostly by means of vehicle patrol. Aircraft, television, ambient air-sampling devices and pollutant-detection instruments can be used as aids in source detection, as discussed in Chapter 4 and other chapters of this manual.

A. Field Patrol

Vehicle patrol is the principal surveillance method. Field enforcement officers drive their vehicles throughout a defined area such as a zone, sector or district,* and major traffic arteries, to observe visible and other evidence of emissions and to detect possible violations of the rules and regulations. The field enforcement officer patrols in a manner that will bring the greatest area of his district under view while taking the shortest route. He observes both specific industrial plants and whole source areas at a time within the radius of his vision. Each location is patrolled at different times each day and maximum use is made of vantage points. When a visible emission is observed, the enforcement officer gets as close as possible and in proper position to read the emissions (see Section III, Plume Evaluation, Chapter 4).

As the enforcement officer becomes familiar with his district, he concentrates on sources requiring the greatest attention, and on areas of high source density. He may employ a check list of facilities that are currently involved in permit cases, hearing board actions, recurrent violations or complaints. (See Figure 2.2.)

Patrols should be conducted with the awareness of the probability of observing violations. The chance of observing recurrent visible violations increases with the interval of time during which the facility is under observation if the observation is randomized with time.(3) For a facility observed 1 hour during each 8-hour day, the probability of observing instantaneous violations in a district during an 8-hour period is 1 in 8. The chance, however, that any instantaneous violation will escape detection in 20 violations is 1 in 16. A district

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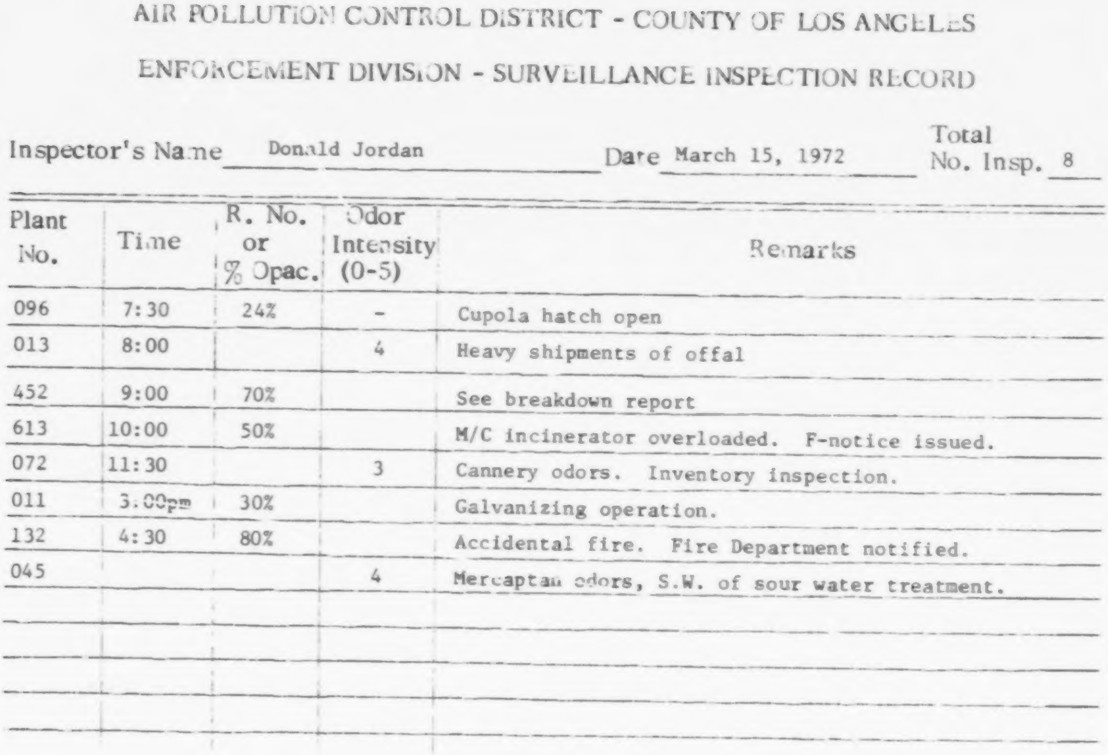
*The term district or inspection or enforcement district will be used for zones or sectors throughout this discussion.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES

ENFORCEMENT DIVISION - SURVEILLANCE INSPECTION RECORD

Inspector's Name Donald Jordan

Date March 15, 1972

Total No. Insp. 8

Plant No.	Time	R. No. or % Opac.	Odor Intensity (0-5)	Remarks
096	7:30	24%	-	Cupola hatch open
013	8:00		4	Heavy shipments of offal
452	9:00	70%		See breakdown report
613	10:00	50%		M/C incinerator overloaded. F-notice issued.
072	11:30		3	Cannery odors. Inventory inspection.
011	3:00pm	30%		Galvanizing operation.
132	4:30	80%		Accidental fire. Fire Department notified.
045			4	Mercaptan odors, S.W. of sour water treatment.

Figure 2.2. SURVEILLANCE INSPECTION RECORD (Courtesy of Los Angeles County Air Pollution Control District)

which enables a field enforcement officer to detect all sources experiencing recurring violations within any month may be considered to be providing adequate surveillance coverage.

The main thrust of the field operations program is directed at activities conducted during normal working hours when most of the air pollution takes place. It is particularly critical to reduce emissions during this time in order to minimize peaks in contaminant concentrations and to prevent episodes.

Some large stationary sources such as power plants, Kraft mills and oil refineries operate continuously, and may gear maximal releases of contaminants during the late afternoon, evening and morning hours to increase productivity. Some of this activity may be deliberate to evade surveillance. Other activities, such as open burning, the use of unapproved incinerators or unpermitted processes may also be conducted at this time.

Air pollution during the evening is in itself undesirable. Fog and atmospheric stagnation, and sometimes air pollution conditions can occur during the evening and early morning hours. Many nuisance complaints are reported at these times since individuals wish to enjoy respite from any form of pollution during their leisure hours.

The scheduling and deployment of enforcement personnel to after-hours surveillance will depend on information on complaints, knowledge of the sources in the individual districts and data on hours of operation. (This information can be retrieved from the source registration system.) During evening hours, travel conditions are such that any point in the community can be easily reached. Therefore, minimal manpower is required during these hours. It is important, however, that contact be maintained with enforcement officers in the field by means of a 2-way radio communications system. Observation and inspection of source activities requiring special attention should be made.

B. Field Surveillance Coverage

Certain administrative activities contribute to the surveillance function. These include the unitization, scheduling and assignment of field work. These determine the degree to which the area is to be kept under observation and the frequency with which emission sources are to be observed and inspected in the field, in relation to available manpower and resources.

1. Unitization of Field Work

The field enforcement officer divides his time among facility inspection, patrol, complaint investigation and other office and field activities. The time available for surveillance is thus related to overall enforcement assignments and work loads. Field assignments may be made on the basis of any one or combination of the following factors:

- Geographic district assignment
- Source emission classification and relative importance
- Facility inspection schedules.

The following units[3] comprise the basis of assignment of field operations activities:

(a) Equipment Unit--a functionally whole piece of basic or air pollution control equipment that is subject to inspection. It is used as a basis for tabulating sources of air pollution as definable points of emission.

(b) Work Unit--a work unit represents a unit of effort of engineering or enforcement activity associated with a specific class of equipment, process or facility. It may represent a range of values (e.g., 1-18) reflecting the complexity of equipment to be inspected and evaluated, or it may be based on expenditures of time (e.g., 15-minute intervals). The work unit is a basis for balancing manpower.

(c) Facility Address-Location--the premises at which a facility is observed and/or inspected. Each address location is subject to a separate inspection report. (Note: a firm may operate facilities at more than one address-location.)

(d) Grid Assignments--this is a coordinate reference system superimposed on a map of the area. The system is usually based on the Universal Trans Mercator (UTM) system which provides for basic unit squares of equal area. Grid systems of this type are used primarily for referencing emission source information (e.g., emission inventory). It can also be used as a basis for establishing enforcement district boundaries and to pinpoint emission sources subject to observation and inspection.

(e) Enforcement Districts--these are administratively defined geographic areas that are used for the assignment of field enforcement personnel. One or more enforcement officers are assigned to each district. The area of the district is based on the number of estimated work units (see above) that can be managed by 1 enforcement officer over a period of time, such as a year. Allowance is made for field patrol and time off for holidays, vacations, sick leave, etc. A given district will be comprised of a combination of grid squares which provide information used in sizing the district.

(f) Surveillance Measures--these include the number of odometer miles driven on patrol of any enforcement districts in any one day together with the time spent in general and specific surveillances of areas and facilities.

The size of an enforcement district is, therefore, associated with equipment units, work or inspection units, number of facility address-locations and the vehicle miles and time required to maintain comprehensive surveillance. The quantitative relationships among these factors are entirely dependent upon the needs, resources and experience of the air pollution control agency.

2. Inspection Scheduling

Inspection scheduling represents another systematic method for effecting the required surveillance since an important part of the inspection process includes source observation. Source inspections, which are treated in the next section, fall into 2 broad categories:

- Unscheduled inspections are a direct result of field surveillance activities. For example, if a field enforcement officer observes a visible emission violation, responds to a citizen's complaint or a report of equipment breakdown, he then conducts a physical inspection of the facility as soon as possible. These types of inspections generally assume priority over scheduled inspections.
- Scheduled inspections are inspections intended to be conducted on or by a certain date, or represent an assigned annual frequency of inspection, which the enforcement officer schedules at his convenience.

Inspection scheduling may be based on source registration, emission inventory and permit system follow-up requirements as shown in Figure 2.1. Frequencies of reinspection also depend on recommendations of field enforcement officers and supervisors made on previous inspections. Ideally, scheduled inspection frequencies should be proportional to the emission potentials of the emission sources, as determined by the emissions inventory and the enforcement management system, shown in Figure 2.1. Accordingly, facilities can be assigned priority inspection categories, for example:

Priority Inspection Category and Frequency	Examples of Emission Sources
I: 4-6 times per year	Steel mills, Kraft mills, aluminum reduction plants, refineries, chemical plants.
II: Twice per year	Plating plants, printing plants, apartment houses, mining operations, woodworking industries.

Priority Inspection Category and Frequency	Examples of Emission Sources
III: Once or less per year.	Commercial establishments, office buildings, warehouse facilities, etc.

Inspection frequencies employed in any given agency may be less or greater than those shown in the above examples.

The scheduling process should not be completely automated. It must rely heavily on the recommendations of the field enforcement officer and the report review process. The management of air pollution problems involves factors that are not always directly related to emission potential. These include, for example, frequency of complaints, equipment breakdowns, violations, number of equipment units, and tha complexity of any given facility.

IV. INSPECTION OF AIR POLLUTION EMISSION SOURCES

An inspection of an air pollution emission source consists of the entry of a facility for the purpose of obtaining information to establish the compliance of specific equipment or processes with the rules and regulations of the air pollution control agency.

A variety of inspections are conducted depending on the reason for the facility visit. These are made to gather evidence in relation to: a violation; follow-up of a previous inspection; a check on equipment for permit or compliance plan status, obtaining source registration; engineering, air or source emission monitoring information; complaint investigation; or providing owners and operators with information on legal requirements.

Many inspections are conducted for a single purpose such as checking to see whether construction is continuing after a permit application has been denied. Other inspections are comprehensive and are conducted to inspect and gather information on all equipment and processes located within the facility.

The types of inspection described below illustrate procedures for conducting the comprehensive type of inspection.

A. Facility Inspection

The facility inspection is a comprehensive inspection made of equipment and processes. Facility inspections are sometimes referred to as "plant inspections," "source inspections," "annual inspections," "inventory inspections," and "scheduled inspections." While terminology and procedures may vary among control agencies, all inspections of this type are concerned with accounting for all possible sources of air pollution located at a facility and with assessing the facility's capability to comply with the rules and regulations.

Facility inspections may also be employed to:

- Ascertain compliance with permit or certification system requirements, where these are in force. In these cases the facility inspection may be referred to as an equipment inventory inspection, described more fully in the next section of this chapter.
- Verify, expand and update all source registration information on hand for the facility. The facility inspection procedure may also be employed as a source registration system in its own right.
- Initiate or check the status of all plans developed by the facility for emissions reduction, episode prevention, air and source monitoring and facility expansion.

The elements of a facility inspection include the following:

(1) Environmental Observations--examination of possible effects of emissions on property, persons and vegetation adjacent to the source and collection of samples or specimens that exhibit possible pollution-related damage.

(2) Observation of the Exterior of the Facility--observation of all possible points of emission, all visible emissions, odors and pollution-related activities.

(3) Entry of Facility and Interview--interview with facility managers and equipment operators. The interview establishes corporate identity, ownership of the organization, operation and air pollution control performance of the facility.

Where extensive or complex manufacturing processes are involved, the interview should be conducted in the facility manager's office. At that time, the facts of the corporation and the responsible individuals are established. The departmental organization, throughputs and outputs, explanation of processes, progress in control, source problems, equipment capacities, source reduction plans, operational practices and fuels and material specifications are discussed. Pertinent facts are noted. The field enforcement officer also works out with the person he is interviewing a plan for conducting a systematic inspection of the plant, including interviews of operators and others who may be most familiar with the equipment. Where possible, the enforcement officer establishes the identity and make of the equipment.

(4) Equipment Inspections--after the interview, the enforcement officer conducts the physical inspection, accompanied by a plant official. At each piece of equipment or process he establishes:

- Identification, number and location of the equipment.
- Principal design features and capacities of the equipment.
- Principal components of the equipment, including blowers, standby equipment, hooding, condensers, air pollution control equipment, air pollution monitoring and process instrumentation, ventilation systems and established or potential effluent sampling points.
- Pertinent process control and air and source monitoring data as may be obtained from instruments, performance logs and records.
- Equipment operating schedule.
- Fuel-firing or material charging or processing rates.
- Emission points, visible emissions, dusts, and odors and deposits that may be noted from within the facility.

- Operational practices or other indicators of the quality of equipment operation and maintenance.

- Evidence of fall-out, property damage or other air pollution effects on the premises.

The field enforcement officer prepares a plot plan showing the location of the equipment and/or a flow chart, especially where complicated processes are involved (see Chapter 7, Section VI D, Petroleum Refineries). Some agencies use special forms, or equipment lists to itemize equipment located in each plant inventory. The plot plan may be made separately. Where source registration or permit systems are involved, the enforcement officer may check listings, plot plans and flow-charts submitted by the applicant.

(5) Provide Information--in promoting future voluntary compliance, the field enforcement officer provides facility management with such useful information as copies or extracts of rules and regulations, permit applications and source registration questionnaires.

(6) Violation Notices--the field enforcement officer issues notices or citations where violations of rules and regulations are observed. Where permits are required, the owner is ordered to submit permit applications by a certain date.

(7) Preparation of Report--the field enforcement officer prepares a narrative report in which he summarizes inspection findings and renders recommendations on actions to be taken and re-inspections. (See Section V.) Calculations of estimated emission rates, flow charts and equipment lists may be attached with the reports.

Items 1 through 4 above may be referred to as general inspection points. Specific inspection points and procedures are followed for each category of emission source, as described in Chapters 5, 6 and 7 of this manual.

B. Equipment Inventory Inspection

The Equipment Inventory Inspection(3) is a form of comprehensive facility inspection which evolved specifically for the purpose of enforcing compliance with permit systems. Equipment inventory inspections obtain complete records of all equipment and processes capable of emitting air contaminants that are located at all facilities within the jurisdictional area. Provided adequate field enforcement manpower is available, the equipment inventory inspection can also be used as a source registration system, as a comprehensive method of inspection and enforcement or other method for rigorously accounting for equipment and processes capable of air pollution.

As in any accounting inventory, the value of the equipment inventory depends on its completeness of application. The completeness possible is problematical and depends on whether the number of emission sources located in the area is infinite or finite with respect to the inspection capability of the agency. An area inventory can be considered to be infinite when all sources of air pollution cannot be inspected in any one year. The number of individual sources located in the area may be so large that before all facilities in the area are inspected, the sources may have undergone significant change. In such cases, the area inventory must be a form of perpetual inventory.

A frequency of inspection should be adopted which reflects industrial turnover and discourages operators from taking risks, especially with respect to permit requirements. Permit infractions can result in the taking of serious risks on the part of management, since investment in equipment discovered to have been constructed and operated illegally may be lost.

1. Source Coverage

A procedure for source coverage should be adopted for inventorying the sources of air pollution that will compensate for the incomplete data resulting from a perpetual inventory system. Source coverage may be random or scheduled, or a combination or sequence of both. In random coverage, the source-locations within any enforcement district are inspected at the enforcement officer's discretion. Although he may systematically schedule his own inspections, the inspections conducted in all districts are randomized. Random inspection is in a sense equivalent to a painter who employs the technique of working the "whole canvas at once." The design of such a canvas becomes apparent much sooner than in the case where the artist proceeds from one of the corners and works systematically from that point without any break in the emerging continuity. Similarly, the practice of random inventory in each enforcement district discloses a source pattern from which emission potentials and mass compliance may be extrapolated. Here the initiative of the enforcement officer and the quality of his work become statistically important.

2. Initial Inventory Inspections

The initial inspection is conducted at a facility for which no previous inventory inspection has been conducted. The following discussion assumes that a district is being approached for the first time to locate all address-locations where sources of air pollution may be found.

It is obviously not wise to inspect all facilities on a block-by-block basis, since valuable time is wasted on many inconsequential sources of air pollution. To increase the effectiveness of the field operations program it is best to conduct inventory inspections first in those plants complained about, those responsible for visible emissions and those involved in variances and violations. All facilities actively involved in enforcement actions should be carefully inventoried. Those industries whose emissions are quite obvious to one observing them from a patrol, such as foundries and steel mills, should be inspected next. Industries under construction, or those recently completed, or appear to have been involved in a change of ownership should be inspected. Information as to where new construction or changes in ownership may be taking place may be obtained from the business license bureau and/or from business lead services. Finally, the enforcement officer should locate all of the areas of high source concentration, first inspecting those sources which appear to be most important, and so on. The final completeness of coverage may be checked against the yellow pages of the telephone directory, which lists industries in categories similar to those employed by the control agency.

Each inspection district may call for a different emphasis in coverage. In the downtown area, for example, where virtually every office building has a heating or steam generating plant, it is desirable to systematically inspect all boiler installations. Because of the complexity of the petroleum industry, unit processes must be inspected frequently and systematically. In other districts, enforcement officers may be concerned primarily with the type of industry predominating in that area.

A field enforcement officer who has become familiar with his district will have accumulated an excellent knowledge of the principal types of source activities and the names and histories of the industrial plants. When he changes districts and encounters industries with which he is unfamiliar, he can consult the agency files and library for any information he may require. A good method of familiarizing oneself with an industry is to concentrate inspections in that industry for a short time.

3. Inventory Reinspections

Inventory reinspections are scheduled. The frequency of reinspection is determined from the findings of the initial inspection and the recommendations of the field officer and his supervisor. The schedules are printed monthly for each district or special assignment and forwarded to the district officer. The reinspections are scheduled so that they can be completed within a month. The number of reinspections assigned per district is based on the estimate that all required inspections can be completed within one year.

The enforcement officer may have occasion to inspect plants out-of-schedule because of complaints or violations. In these cases, he does not make a formal inventory reinspection, but uses the copy of the previous inventory record (equipment list, see below) from his files as a check on the permit, compliance or other status. When a specific air pollution problem is involved, it is best to concentrate on that problem rather than on the inventory of the entire plant. The equipment list can thus be updated during unscheduled inspections.

The equipment list can be used as a tool in gathering evidence. This is especially true in public nuisance cases where it is desirable to eliminate from suspicion all equipment that do not contribute to the nuisance. In such instances, the equipment list serves as a check list.

On an assigned inspection, the enforcement officer must check all equipment units in the plant against those on the equipment list. He is careful to note not only that all equipment listed is identical in important respects, but are not replacements, since permit regulations can be affected by replacements. This is usually determined by comparing manufacturers' serial numbers. He also checks for new equipment, alteration of equipment, posting of permits, operation contrary to conditions of permit, etc. Any discrepancies noted are recorded in detail on an inspection report.

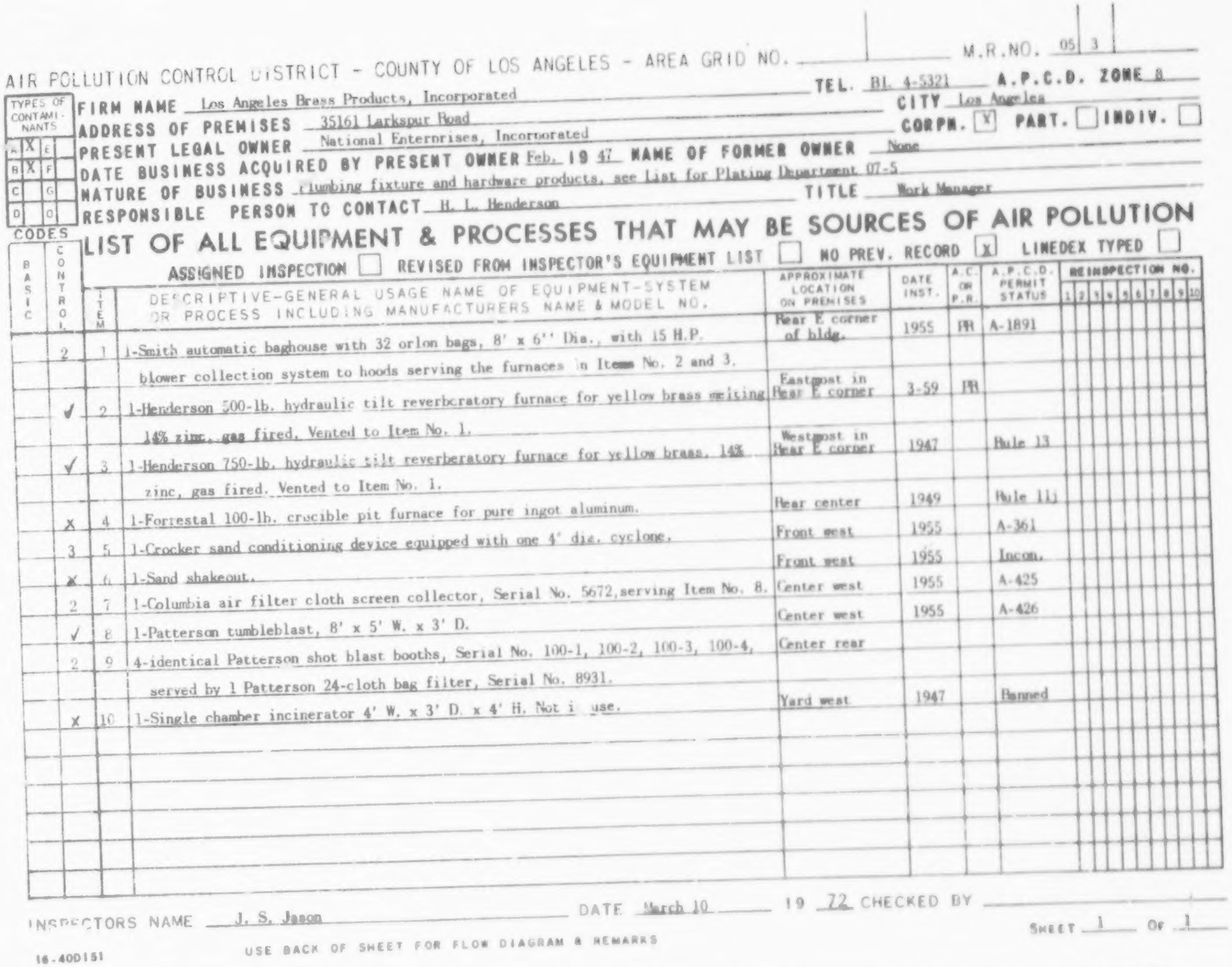
4. The Equipment List

The record of the equipment inventory is referred to as an equipment list. The equipment list enumerates all items of equipment capable of emitting air contaminants that are located on the premises of a company at a given address-location, and the status of the equipment with respect to compliance with the permit system and the rules and regulations.

The use of the equipment list reflects the practices of the Los Angeles County Air Pollution District and is illustrated in Figures 2.3 through 2.5 and Tables 2.1 and 2.2. It is used by the L.A. District as a method of enforcing the permit system, the effectiveness of which depends on (1) a high degree of coordination between the engineering and enforcement branches of the District (the Engineering Division is responsible for the administration of the system) and (2) data processing and management systems to handle the large volumes of data generated by the system, to schedule both engineering and enforcement inspections and to retrieve any data required.

Information from the equipment list is input to the permit system data base whenever an enforcement officer makes out a new or updates an old equipment list of a facility. It outputs data from the permit system to schedule inventory inspections, and, while doing so, prints out the exact permit descriptions of the equipment.

From the standpoint of agencies that do not operate permit or data management systems, it is useful to illustrate the version of the equipment list used prior to the introduction of automation (see Figure 2.3). This figure best illustrates the systematic inventory technique and the descriptive skills required of the



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES - AREA GRID NO. ______ M.R.NO. 05 3

TYPES OF CONTAMINANTS
A ☒ E ☐
B ☒ F ☐
C ☐ G ☐
D ☐ O ☐

FIRM NAME Los Angeles Brass Products, Incorporated TEL. BI 4-5321 A.P.C.D. ZONE 8
ADDRESS OF PREMISES 35161 Larkspur Road CITY Los Angeles
PRESENT LEGAL OWNER National Enterprises, Incorporated CORPN. ☒ PART. ☐ INDIV. ☐
DATE BUSINESS ACQUIRED BY PRESENT OWNER Feb. 19 47 NAME OF FORMER OWNER None
NATURE OF BUSINESS Plumbing fixture and hardware products, see List for Plating Department 07-5
RESPONSIBLE PERSON TO CONTACT H. L. Henderson TITLE Work Manager

LIST OF ALL EQUIPMENT & PROCESSES THAT MAY BE SOURCES OF AIR POLLUTION

ASSIGNED INSPECTION ☐ REVISED FROM INSPECTOR'S EQUIPMENT LIST ☐ NO PREV. RECORD ☒ LINEDEX TYPED ☐

CODES									REINSPECTION NO.									
BASIC	CONTROL	ITEM	DESCRIPTIVE-GENERAL USAGE NAME OF EQUIPMENT-SYSTEM OR PROCESS INCLUDING MANUFACTURERS NAME & MODEL NO.	APPROXIMATE LOCATION ON PREMISES	DATE INST.	A.C. OR P.R.	A.P.C.D. PERMIT STATUS	1	2	3	4	5	6	7	8	9	10
	2	1	1-Smith automatic baghouse with 32 orlon bags, 8' x 6'' Dia., with 15 H.P. blower collection system to hoods serving the furnaces in Items No. 2 and 3.	Rear E corner of bldg.	1955	PR	A-1891										
	✓	2	1-Henderson 500-lb. hydraulic tilt reverberatory furnace for yellow brass melting 14% zinc, gas fired. Vented to Item No. 1.	Eastmost in Rear E corner	3-59	PR											
	✓	3	1-Henderson 750-lb. hydraulic tilt reverberatory furnace for yellow brass. 14% zinc, gas fired. Vented to Item No. 1.	Westmost in Rear E corner	1947		Rule 13										
	x	4	1-Forrestal 100-lb. crucible pit furnace for pure ingot aluminum.	Rear center	1949		Rule 11j										
	3	5	1-Crocker sand conditioning device equipped with one 4' dia. cyclone.	Front west	1955		A-361										
	x	6	1-Sand shakeout.	Front west	1955		Incon.										
	2	7	1-Columbia air filter cloth screen collector, Serial No. 5672, serving Item No. 8.	Center west	1955		A-425										
	✓	8	1-Patterson tumbleblast, 8' x 5' W. x 3' D.	Center west	1955		A-426										
	2	9	4-identical Patterson shot blast booths, Serial No. 100-1, 100-2, 100-3, 100-4, served by 1 Patterson 24-cloth bag filter, Serial No. 8931.	Center rear													
	x	10	1-Single chamber incinerator 4' W. x 3' D. x 4' H. Not in use.	Yard west	1947		Banned										

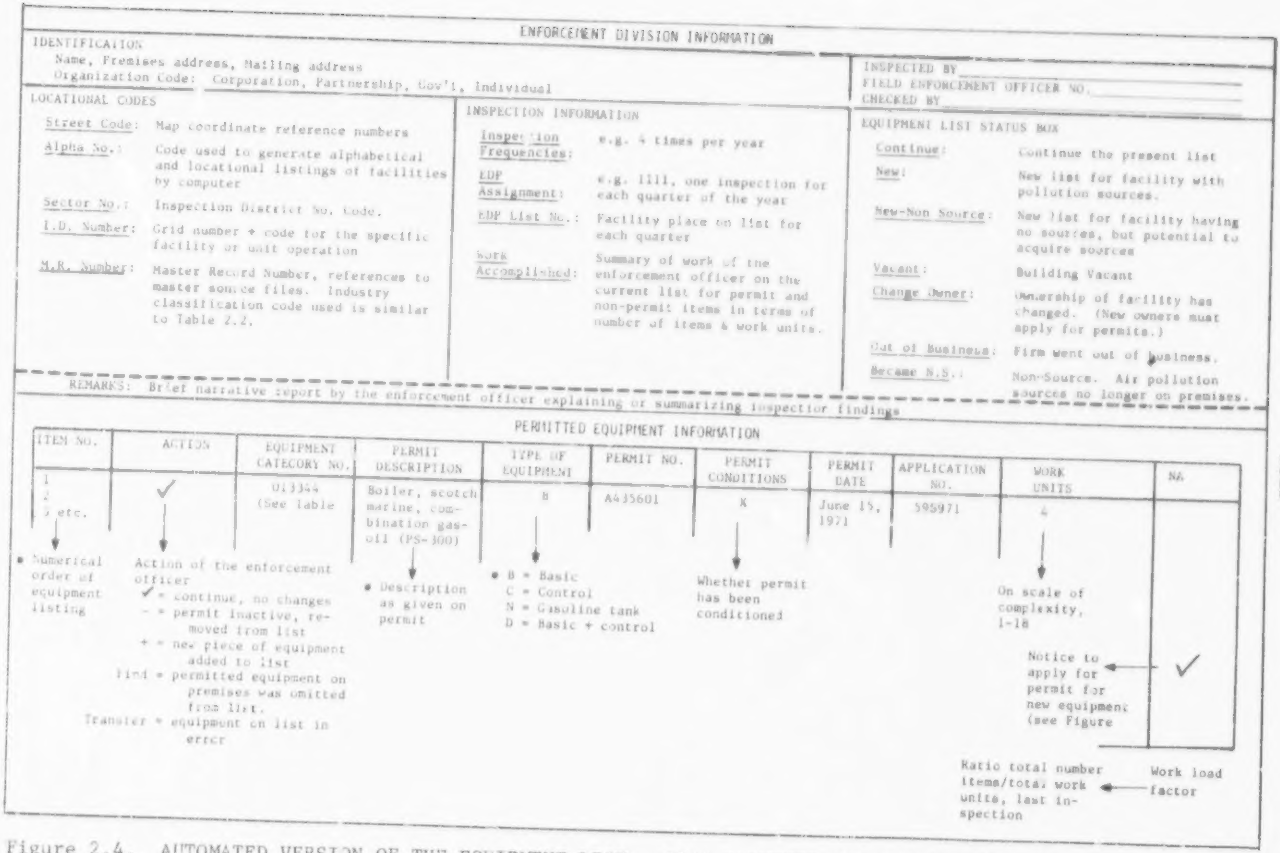
INSPECTORS NAME J. S. Jason DATE March 10 19 72 CHECKED BY ______

USE BACK OF SHEET FOR FLOW DIAGRAM & REMARKS

SHEET 1 OF 1

16-400151

Figure 2.3. EQUIPMENT LIST USED FOR INVENTORYING THE SOURCES OF POLLUTION AT AN INDUSTRIAL FACILITY



ENFORCEMENT DIVISION INFORMATION

IDENTIFICATION
Name, Premises address, Mailing address
Organization Code: Corporation, Partnership, Gov't, Individual

INSPECTED BY________
FIELD ENFORCEMENT OFFICER NO.________
CHECKED BY________

LOCATIONAL CODES

Street Code:	Map coordinate reference numbers
Alpha No.:	Code used to generate alphabetical and locational listings of facilities by computer
Sector No.:	Inspection District No. Code.
I.D. Number:	Grid number + code for the specific facility or unit operation
M.R. Number:	Master Record Number, references to master source files. Industry classification code used is similar to Table 2.2.

INSPECTION INFORMATION

Inspection Frequencies:	e.g. 4 times per year
EDP Assignment:	e.g. 1111, one inspection for each quarter of the year
EDP List No.:	Facility place on list for each quarter
Work Accomplished:	Summary of work of the enforcement officer on the current list for permit and non-permit items in terms of number of items & work units.

EQUIPMENT LIST STATUS BOX

Continue:	Continue the present list
New:	New list for facility with pollution sources.
New-Non Source:	New list for facility having no sources, but potential to acquire sources
Vacant:	Building Vacant
Change Owner:	Ownership of facility has changed. (New owners must apply for permits.)
Out of Business:	Firm went out of business.
Became N.S.:	Non-Source. Air pollution sources no longer on premises.

REMARKS: Brief narrative report by the enforcement officer explaining or summarizing inspection findings

PERMITTED EQUIPMENT INFORMATION

ITEM NO.	ACTION	EQUIPMENT CATEGORY NO.	PERMIT DESCRIPTION	TYPE OF EQUIPMENT	PERMIT NO.	PERMIT CONDITIONS	PERMIT DATE	APPLICATION NO.	WORK UNITS	NA
1 2 3 etc.	✓	013344 (See Table	Boiler, scotch marine, combination gas-oil (PS-300)	B	A435601	X	June 15, 1971	595971	4	✓

- Numerical order of equipment listing

Action of the enforcement officer
✓ = continue, no changes
– = permit inactive, removed from list
+ = new piece of equipment added to list
Find = permitted equipment on premises was omitted from list.
Transfer = equipment on list in error

- Description as given on permit

- B = Basic
C = Control
N = Gasoline tank
D = Basic + control

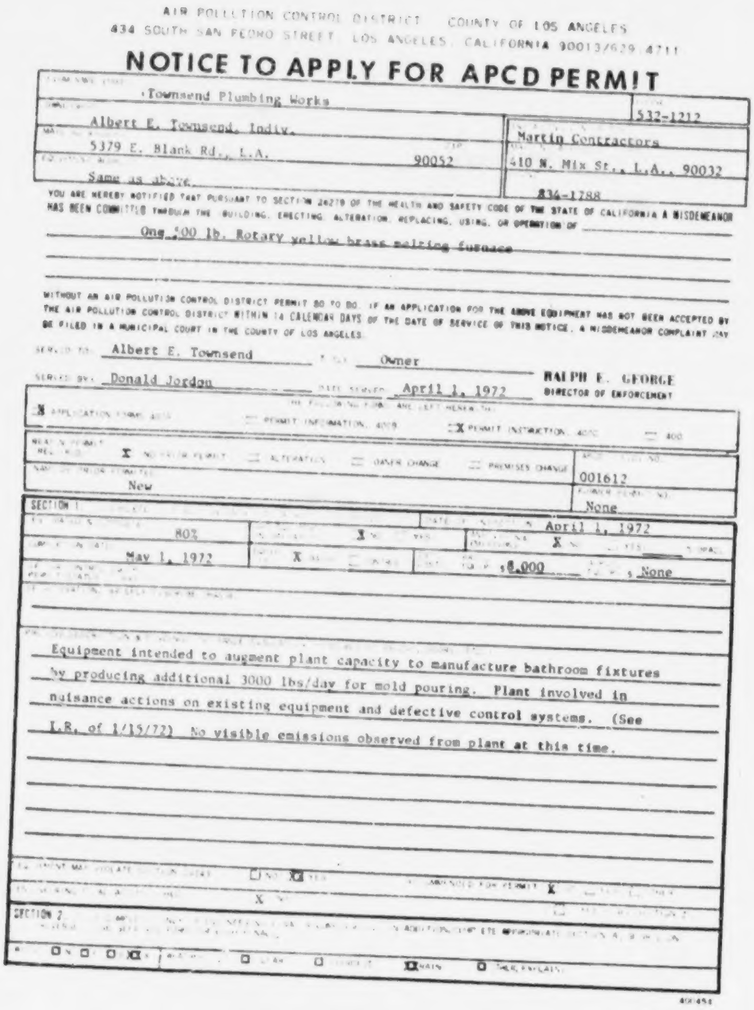
Whether permit has been conditioned

On scale of complexity, 1-18

Notice to apply for permit for new equipment (see Figure

Ratio total number items/total work units, last inspection ← Work load factor

Figure 2.4. AUTOMATED VERSION OF THE EQUIPMENT LIST. CODE ELEMENTS AND COMPONENTS. (From information supplied by the Los Angeles County Air Pollution Control District.)



AIR POLLUTION CONTROL DISTRICT   COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET LOS ANGELES, CALIFORNIA 90013/629-4711

NOTICE TO APPLY FOR APCD PERMIT

Townsend Plumbing Works
532-1212
Albert E. Townsend, Indiv.
5379 E. Blank Rd., L.A. ZIP 90052
Same as above
Martin Contractors
410 N. Mix St., L.A., 90032
834-1788

YOU ARE HEREBY NOTIFIED THAT PURSUANT TO SECTION 24279 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA A MISDEMEANOR HAS BEEN COMMITTED THROUGH THE BUILDING, ERECTING, ALTERATION, REPLACING, USING, OR OPERATION OF

One 500 lb. Rotary yellow brass melting furnace

WITHOUT AN AIR POLLUTION CONTROL DISTRICT PERMIT SO TO DO. IF AN APPLICATION FOR THE ABOVE EQUIPMENT HAS NOT BEEN ACCEPTED BY THE AIR POLLUTION CONTROL DISTRICT WITHIN 14 CALENDAR DAYS OF THE DATE OF SERVICE OF THIS NOTICE, A MISDEMEANOR COMPLAINT MAY BE FILED IN A MUNICIPAL COURT IN THE COUNTY OF LOS ANGELES.

SERVED TO: Albert E. Townsend   Owner
SERVED BY: Donald Jordon   DATE SERVED April 1, 1972

RALPH E. GEORGE
DIRECTOR OF ENFORCEMENT

☒ APPLICATION FORMS   ☐ PERMIT INFORMATION   ☒ PERMIT INSTRUCTION   ☐ 400

☒ NO PRIOR PERMIT   ☐ ALTERATION   ☐ OWNER CHANGE   ☐ PREMISES CHANGE
New
001612
None

SECTION 1
80%
April 1, 1972
May 1, 1972
$8,000 $ None

Equipment intended to augment plant capacity to manufacture bathroom fixtures by producing additional 3000 lbs/day for mold pouring. Plant involved in nuisance actions on existing equipment and defective control systems. (See I.R. of 1/15/72) No visible emissions observed from plant at this time.

☐ NO ☒ YES

SECTION 2

Figure 2.5. NOTICE TO APPLY FOR APCD PERMIT (Los Angeles County Air Pollution Control District)

Table 2.1. MAJOR BASIC EQUIPMENT CLASSIFICATION

Unit	Type of Equipment	Code Numbers
Combustion Equipment	Equipment in which the major air pollution problem is due to the combustion system and not the materials processed; i.e., boilers, heaters, kilns, not handling fine solids, etc.	01XXXX series
Metallurgical	Metal melting furnaces.	001XXX series
Incinerators	Incinerators (trash) and other incineration equipment.	0001XX series
All	Equipment which is primarily used to process unit material; i.e., ovens, dip tanks, sheet coating, dry cleaning, smoke houses, and degreasers.	0002XX series
All	Equipment which is primarily used to process bulk material. The first three digits specify the major material processed and the last three, the major unit operation(s) performed in the permit unit. Includes refineries, chemical processing, sand handling, reactors, spray dryers, coffee roasters, feed and grain, rendering, etc.	1XXXXX series

Example of Code:

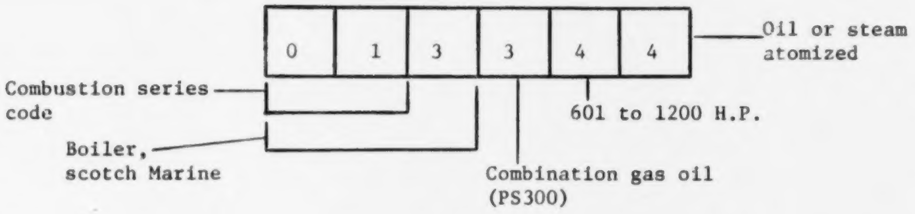

0
1
3
3
4
4
Oil or steam atomized
Combustion series code
601 to 1200 H.P.
Boiler, scotch Marine
Combination gas oil (PS300)

Table 2.2. PRIMARY ACTIVITY CLASSIFICATIONS

PETROLEUM AND PETRO-CHEMICAL DEVELOPMENT, PROCESSING AND MARKETING - 01

1 Refineries
2 Bulk Gasoline Marketing Facilities, Rule 61 Actual or Potential
3 Petroleum Production and Related Operations
4 Bulk Storage of Petroleum Distillates, Rule 56 Tank Farm and Marine Terminal
5 Asphalt Manufacturing and Felt Saturators
6 Heavy Hydrocarbons e.g. Blending, Compounding and Marketing of Fuel Oils, Asphalt, Grease, Lube Oils, Road Oils, etc
7 Re-refiners, Solvents and Lube Oil
8 Petro Chemical Manufacturing
9 Sulfur Recovery Plants

INDUSTRIAL CHEMICAL MANUFACTURING AND PROCESSING (EXCLUDING PETRO-CHEMICAL) - 02

1 Soaps and Detergents
2 Insecticides and Herbicides, Compounding and Packaging
3 Chemical Specialties e.g. Compounding and Packaging of Pharmaceuticals, Cosmetics, Aerosols, Household and Janitorial Chemicals, etc
4 Industrial and Automotive Chemicals
5 Manufacturing and Packaging of Gases
6 Explosives, Rocket Propellants and Pyrotechnics
7 Radio Active Materials, Isotopes and Related Materials
8 Chemical Processes Involving Chlorination
9 Catalysts
10 Organic Chemicals
11 Inorganic Chemicals

PAINTS AND RELATED MATERIALS, MANUFACTURING AND HANDLING - 03

1 Paint Type Products e.g. Lacquer, Varnish, Shellac, Ink, Enamel, Powder Paints, Water Emulsion Paints, etc
2 Paint Additives e.g. Pigments, Dryers, Surfactants, etc
3 Polymers and Resinous Materials
4 Marketing of Solvents and Liquid Chemicals
5 Vegetable and Animal [illegible] Processing (excluding [illegible] and Food Processing)
6 Adhesives e.g. Sealants, Putties, Calking Compounds, Masking Compounds, etc

PLASTIC, RUBBER AND RESIN PROCESSING - 04

1 Rubber Products Processing e.g. Molding, Dipping, Coating, etc (excluding Tires)
2 Rubber Reclaiming
3 Tire Recapping
4 Plastic and Resin Molding e.g. Injection Molding, Compression Molding, Extrusion Molding, Permanent Molding, etc
5 Plastic and Resin Fabrication e.g. Laminating, Coating, Embedding, Sheet Forming, etc
6 Tire Manufacturing

METAL MELTING AND RECLAIMING - 05

1 Grey Iron Foundry Facilities
2 Steel Foundry Facilities
3 Brass Foundry Facilities
4 Aluminum Foundry Facilities
5 Magnesium Foundry Facilities
6 Miscellaneous Non-Ferrous Foundry Facilities
7 Secondary Refiners
8 Core Making Facilities
9 Die Casting Facilities

METAL FABRICATING - 06

1 Electrical and Electronic Equipment Manufacturing
2 All Instrument Manufacturing, Repairing and Rebuilding
3 Structural Metal Fabricating and Forming
4 Sheet Metal Fabricating e.g. Punch Pressing, Drawing, Metal Spinning, Tube Drawing, etc
5 Welding, Blacksmithing, Forging, Swaging, Cold Heading, Upsetting, etc
6 Heavy Machinery Manufacturing and Reconditioning
7 Metal Cutting e.g. Machine Shops, Tool and Die Shops, Oil Tool Manufacturing and Reconditioning, etc
8 Battery Manufacturing, Assembling and Rebuilding
9 Wire Products Manufacturing e.g. Springs, Cables, Wire Forms, Metal Cloth, Wire Drawing, etc
10 Powdered Metal Processing

SURFACE FINISHING AND COATING - 07

1 Galvanizing Facilities and Plants including Dip Tinning
2 Sand Blasting and Abrasive Blasting Facilities
3 Heat Treating Plants
4 Printing on Metal
5 Plating Facilities
6 Surface Coating and Protective Treating of Materials e.g. Pickling, Parkerizing, Bonderizing, Corrosion Preventive Coatings, Vacuum Coating, Metallizing, Anodizing, etc
7 Surface Grinding and Polishing e.g. Centerless, Surface, Lapping, Honing, etc
8 Painting and Enameling, Major Users
9 Display Sign Manufacturing and Servicing

MINERAL PROCESSING - 08

1 Sand and Gravel Plants, Rock Plants, Concrete Batch Plants, Cement Storage and Handling Facilities
2 Asphalt Paving Plants e.g. Hot Plants
3 Ceramic Processing e.g. Brick, Tile, Clay Products, Refractories, etc
4 Glass, Frit and Rock Wool Manufacturing, including Vermiculite and Perlite Plants
5 Mixing, Grinding, Blending and Packaging of Miscellaneous Mineral Base Products

WOODWORKING AND FURNITURE MANUFACTURING - 09

1 Lumber Yards, including Sash and Door Mills
2 Furniture Manufacturing, Repairing and Refinishing, including the Use of all Materials
3 Casket and Cabinet Shops
4 Wood Treating Facilities e.g. Termite Proofing, Creosoting, Flame Proofing, etc
5 Pattern Shops, all Types
6 Wood Turning Facilities
7 Wooden Shipping Materials e.g. Pallets, Crating, Skids, Cooperage, etc
8 Wood Laminating e.g. Plywood Veneering, Formica Bonding, etc
9 Wood By Products Plants e.g. Sawdust, Wood Flour, Shaving, Briquets, etc

FOOD PROCESSING - 10

1 Meat Smoking, Packing, Canning, including Lard Rendering
2 Fish Smoking and Canning (excluding by products)
3 Bakeries
4 Coffee Roasting
5 Dairy Products Processing including Dried Milk, Condensed Milk, Ice Cream, etc
6 Grain and Feed Milling, Flour Milling, Cereal Packaging, etc
7 Fruit and Vegetable Canning and Packaging
8 Beverage Manufacturing
9 Pet Foods, All Types
10 Food Specialty Packaging e.g. Spices, Condiments, Flavorings, etc
11 Margerine and Oleaginous Products

INEDIBLE ANIMAL AND VEGETABLE BY-PRODUCT PROCESSING - 11

1 Rendering
2 Fertilizer Processing and Packaging
3 Fish Cannery By Products Processing
4 Tanneries and Hide Processing
5 Wool Processing
6 Dehydrating Food By Products

HOTELS, APARTMENTS AND OFFICE BUILDINGS (EXCLUDING GOVERNMENTAL) - 12

1 Office Buildings
2 Private Medical Facilities and Private Hospitals e.g. Sanitoriums, Hospitals, Clinics, Rest Homes, etc
3 Private and Religious Schools, Colleges, etc
4 Motels, Courts and Trailer Parks
5 Apartment Hotels and Apartment Buildings
6 Scientific Research and Development Facilities
7 Scientific Laboratories e.g. Testing, Metallurgical, Bacteriological, etc (excluding Medical and Dental and Film Processing)

COMMERCIAL ACTIVITIES - 13

1 Retailing Activities, Consumer Sales and Equipment Rentals
2 Wholesalers, Jobbers, Warehouses and Contractors' Yards
3 Electrical and Electronic Repairing, Rebuilding and Servicing
4 Motion Picture and Television Production Facilities
5 Photographic Arts and Processing e.g. Studios (excluding Motion Picture and TV), Film Laboratories, Commercial Artists, Photo Duplicating including Blueprinting and Ozalid
6 Laundries, Rug Cleaning, etc
7 Cafes, Restaurants and Bars (excluding those in hotels)
8 Printing Shops, Newspapers and Publishers
9 Mortuaries, Crematories and Cemeteries
10 Graphic Arts Specialties and Services e.g. Engravers, Photoengravers, Electrotypers, Mat makers, Silk Screening, Printed Circuits, etc
11 Dry Cleaning Plants
12 Junk Yards, Salvaging and Converting of Industrial Materials (excluding Secondary Metal Refining)
13 Business Machines, Sales and Servicing
14 Household Appliances, Sales and Servicing
15 Amusement and Recreational Facilities
16 Agricultural Operations

GOVERNMENTAL AGENCIES AND PUBLIC UTILITIES - 14

1 Public Office Buildings
2 Public Schools, Colleges, Universities, etc
3 Municipal Incinerators and Disposal Facilities including Sewage Treatment Facilities
4 Publicly and Privately Owned Power Plants Generating Power and/or Steam for Public Use
5 Publicly and Privately Owned Public Utility Facilities e.g. Telephone Co., Gas Co., Waterworks, etc
6 Governmentally Owned Hospitals
7 Cut and Fill Dumps
8 Transportation Facilities, Terminals, Depots, Stations, etc., for all Transportation Media
9 Governmentally Owned Shipyards

VEHICLE MANUFACTURING AND SERVICING FACILITIES - 15

1 Airframe Production including Guided Missiles
2 Auto and Truck Assembling
3 Trailer Manufacturing and Assembling
4 Aircraft Overhaul Facilities
5 Automotive Component Rebuilding Facilities e.g. Engines, Transmissions, Carburetors, Starters, Generators, Water Pumps, etc
6 Custom and Special Vehicle Manufacturing (excluding Trucks and Trailers)
7 Auto Wreckers
8 Vehicle Dealers
9 Vehicle Repair Facilities including Vehicle Body Repair Shops
10 Shipyards, Boat Building, Boat Repair, Dry Docks, etc (excluding Governmentally Owned)
11 Railroad Service and Repair Facilities, Yards, Roundhouses, etc (excluding Stations, Depots and Warehouses)

TEXTILE, FABRIC, FIBER, MONOFILAMENT MANUFACTURING AND PROCESSING - 16

1 Garment Manufacture
2 Textile and Fabric Coverings Manufacturing e.g. Seat Covers, Tents, Tarpaulins, Draperies, Awnings, etc
3 Textile and Fabric Processing e.g. Sponging, Shrinking, Waterproofing, Dyeing, Flameproofing, Printing, etc
4 Mattress, Cushion and Pad Manufacturing and Renovating (excluding Furniture Manufacturing)
5 Paper Products
6 Shoe and Luggage Manufacturing, etc
7 Brush Manufacturing
8 Special Textiles e.g. Felt, Webbing, Rope, Cordage, Packings, Oakum, Belting, etc
9 Weaving of Textile Materials e.g. Braid, Tape, Lace, Bindings, Rugs, etc

(SOURCE:

field enforcement officer. With the use of supporting report forms this procedure could be employed by some agencies in administrating a source registration-plan review system. Figure 2 3 also illustrates the experience in manual procedures that an enforcement agency may need prior to the introduction of Electronic Data Processing.

Figure 2.4 and Tables 2.1 and 2.2 illustrate the components of a printout of an automated version of the equipment list, which is more sophisticated and complex than the earlier version. In this procedure, the inventory inspection has been fully incorporated into the permit system, and the enforcement officer interacts directly with the data base of the permit system. Information on applications received for permits, and the status of permits (approvals, denials, variances, etc.) are quickly and accurately relayed to the enforcement officer on each scheduled printout of the equipment list. Equipment descriptions and coding elements are completely standardized, so that the permit system can perform listings, tabulations, and statistical analyses on the entire equipment source population at any time.

Figure 2.4 illustrates the components and elements printed out by the system and the data that must be updated by the enforcement officer. Whenever equipment is found at a facility which does not have a permit, a Notice to Apply for Permit (Figure 2.5) is issued. This notice initiates the permit application procedure.

The procedures for preparing equipment lists, described below, are generalized for the purpose of illustrating principles and methods of the inventory inspection whether or not these are incorporated as automated procedures or field enforcement techniques.

5. Preparation of the Equipment List

The inventory unit for which one equipment list is made may be referred to as an activity. The activity is an industrial plant or a commercial enterprise occupying one address-location, or unit operation capable of standing alone as an independent source activity, but which is integrated into a large industrial plant at one address-location. Industrial facilities that are highly diversified or contain so many equipment units that they cannot be inventoried in one continuous inspection are unitized for the purpose of establishing equipment list boundaries. The individual units are scheduled for separate reinspections. These particularly include plants with elaborate departmental flow structures, such as oil refineries, aircraft plants, chemical plants, large steel mills and metal fabricating plants.

Source activities may be classified by means of a primary and a secondary activity classification system (see Table 2.2). The Primary Activity Classification breaks the industrial economy of the region down into general technological or commercial activities grouped according to similar emission potentials. This classification may be based on the Standard Industrial Classification System (SIC), or other systems.(4)

Each primary activity is composed of the secondary "source activities" which would be found at individual address-locations. For example, the "Metal Melting and Reclaiming Activity," a primary activity classification, is coded as "05," while the secondary source activities comprising the classification are as follows:

(1) Gray Iron Foundry Facilities
(2) Steel Foundry Facilities
(3) Brass (Red and Yellow) Foundry Facilities
(4) Aluminum Foundry Facilities
(5) Magnesium Foundry Facilities
(6) Miscellaneous Non-ferrous Foundry Facilities and Die Cast
(7) Secondary Refiners
(8) Core Making Facilities

The brass foundry facility (05-3), for example, is a source activity, whether it is a complete self-contained plant or an independent commercial activity, as it is usually found, or a department within a large industrial plant such as a large plumbing products manufacturing plant. In the example of a large plumbing products plant, additional source activities may be found such as a plating department or a machine shop. These are coded as separate source activities under other primary and secondary activity classifications. Specific types of equipment, such as a rotary furnace, boiler, oil-water separator, electrical precipitator, can be further coded by means of Basic Equipment Classification (BEC) and Control Equipment Classification (CEC) codes. (See Table 2.1.)

If an industrial unit within a plant at one address-location can be conveniently classified and given a primary and secondary classification code number which differs from those which may be assigned to the remaining departments or units within the plant, a separate equipment list is made. In order to locate all the source activities with different classifications which may be found at one address-location, a visible reference cross-indexed file or a data management system can be used to recombine these source activities alphabetically.

The equipment list is prepared for an activity only if there are sources of air pollution on the premises. The "non-source" activity may still be accounted for in 2 ways. First, the enforcement officer reports the name and location of the company, the nature of business, the expansion potential of the company, or any indication of the likelihood of the establishment installing equipment capable of air pollution in the future. This indication is important for scheduling a reinspection. If the plant is a type of activity such as a warehouse in which no sources of air pollution can be expected to be added to the premises, it should be scheduled for reinspection on a frequency "0" basis. If, on the other hand, the plant is a small plating shop with a few plating tanks but a great deal of unoccupied floor space, that plant might expand its manufacturing operation to include other tanks or operations and should be inspected at least once each year.

The equipment list (Figure 2.3) is broken down into four basic parts: business and ownership data of the source activity, description and location of each piece of equipment, permit status of each equipment unit, and coded equipment data.

a. Business and Ownership Data of the Source Activity

All business and ownership data are contained on the heading of the equipment list. The heading is usually filled out during the initial interview with plant management in order to gather the background data necessary for the determination of the permit status of each piece of equipment to be inspected. The procedures for identifying the company, its type of ownership, its owners, officers or managers, are the same as for handling of violation notices. The information called for on the equipment list, however, is broken down in detail so that all of the data which may affect the permit status of the equipment in the plant are included.

The elements of the data pertinent to the permit status are (1) the present legal owner, (2) the date the business was acquired by the present owner and (3) the name of the former owner.

On the line entitled "Nature of Business," an inclusive description of the general purposes and processes of the enterprise and the products produced should be recorded. The terminology listed in the activity classification such as "office building," "brass foundry facilities," "plating facility," should be included. A more detailed explanation of the nature and size of the business can be given on the reverse of the equipment list, for example:

(1) End product manufactured, processed or produced

(2) Raw materials used

(3) Approximate size of plant in terms of production volume, men employed, square feet of plant area, etc.

(4) Number of shifts worked and normal working hours of plant

(5) Flow sheets of process plants.

Where several primary activities are carried on at the same premises, separate equipment lists are made to cover each source activity of substantial magnitude.

b. Description and Location of Each Equipment Unit

The main purpose of the inventory is to list, itemize and to identify by description each equipment unit in the squrce activity.

An equipment unit is an identifiable piece of equipment which operates as a complete functioning unit either as a solitary piece of equipment or as a cluster of related equipment, consisting of a primary operating unit equipped with or served by auxiliary equipment, appurtenances, controls, heating elements or equipment parts. Equipment units can either stand alone or be a component of a battery or process by interconnection with other equipment units. With respect to the inventory process, equipment units may or may not constitute sources of air pollution.

A source of air pollution is that specific outlet, stack or other opening from which air pollutants may be emitted into the atmosphere. The pollutants emitted are generated by the equipment unit and discharged through the stack or exhaust system serving that equipment unit, or are generated by a number of equipment units and are exhausted through 1 stack effluent system, or into the general atmosphere through a louvre, roof monitor, vent, etc.

The description of an equipment unit includes all auxiliary equipment, appurtenances, etc., which are relevant to a description of the equipment as a source of air pollution. All equipment appurtenances which are of a minor character, or are irrelevant to characterizing the equipment unit as a source of air pollution are omitted from the cluster description. The ability to describe equipment reflects an understanding of the variables affecting the air pollution potential of the equipment unit.

Equipment units capable of emitting air contaminants fall into 2 classes:

(1) Basic Equipment

This class includes any articles, machine, equipment or other contrivance, the use of which may cause the issuance of air contaminants.

(2) Air Pollution Control Equipment

This class includes any article, machine, equipment or other contrivance, the use of which may eliminate or reduce or control the issuance of air contaminants.

Figure 2.6 diagrams a control system for two brass furnaces of the reverberatory rotary type.

Each reverberatory furnace is a basic unit of equipment, equipped with shell, refractory, rotary and tilting devices, and oil or gas burners. Thus, there are 2 basic equipment units in battery.

The control unit consists of the entire collection system: hoods, cooling ducts, motor and fan, baghouse and hopper. A description of the control unit includes the number of bags, the material used, the size, whether the baghouse is automatically or manually rapped, the blower horsepower and type of precooling system. (In this case, radiational.) In this example, 1 unit of collection equipment serves 2 units of basic equipment.

c. Itemization of Equipment Units

The itemization of equipment units on the equipment list comprises the actual inventory or accounting process. The item column may be noted in the left-hand column of the equipment list in Figures 2.3 and 2.4. Equipment units are itemized in counting order. Only those equipment units, the use of which may cause the emission or reduction of air contaminants, are itemized. All equipment which may be sources of air pollution but exempted are also listed. Equipment units

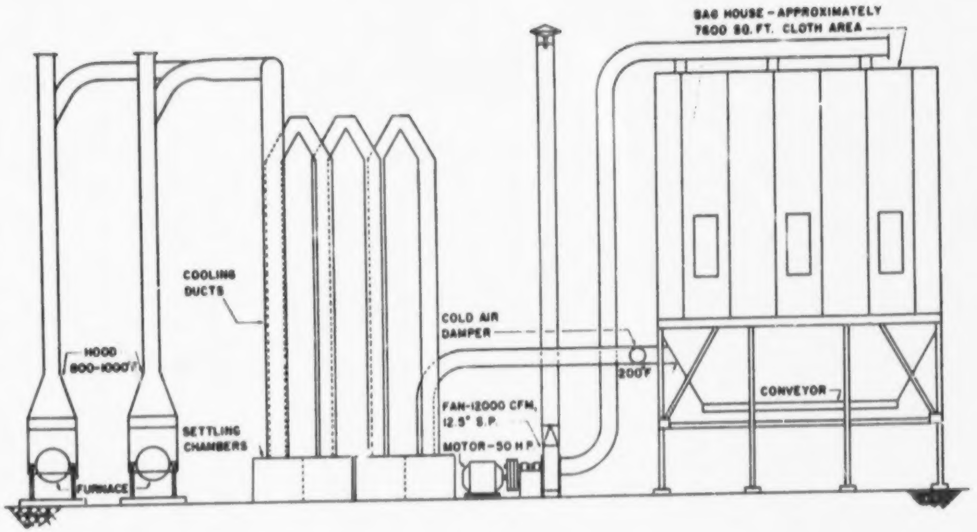

BAG HOUSE - APPROXIMATELY
7600 SQ. FT. CLOTH AREA
COOLING
DUCTS
COLD AIR
DAMPER
200°F
HOOD
800-1000°F
CONVEYOR
FAN-12000 CFM,
12.5" S.P.
SETTLING
CHAMBERS
MOTOR-50 H.P.
FURNACE

Figure 2.6. DIAGRAM OF BASIC AND CONTROL EQUIPMENT FOR TWO BRASS FURNACES SERVED BY COOLING COLUMNS AND CLOTH FILTERING SYSTEMS

(SOURCE: WEISBURD, Reference 3)

which are clearly non-sources are not itemized. Equipment which emits very small amounts of air pollution is listed, but is noted as "inconsequential."

The enforcement officer has considerable latitude in itemizing equipment to fit the groupings which he encounterd and the relative importance of each piece of equipment. An important piece of equipment may be handled as a separate itemization and with considerably more detail than one which is of little consequence. Generally, the description is based on one of the following equipment groupings: (1) individual equipment units, (2) more than 1, but exactly identical equipment units, (3) control-basic equipment combinations, (4) equipment battery combinations and (5) process unit combinations.

Individual equipment units are described according to their mechanical or chemical function as "boiler," "incinerator," "furnace," "spray booth," etc. In a detailed description all auxiliary equipment are included.

Exactly identical equipment units may be grouped together as long as the equipment is identical as to structure and use and the exact number of equipment units is given.

The battery or series of equipment units refers to a group of similar (but not always) individual equipment units not contributing to a process, but exhausting through 1 system. For example, a power plant may consist of 5 boilers in battery exhausting through one exhaust system or stack. A plating plant may have several plating tanks in series which exhaust through 1 blower or control system.

The Process Unit may be defined as a group of equipment or process vessels which are interconnected by sealed or ducted flow systems such as might be found in a refinery or petrochemical plant. The product moving through the unit is progressively transformed towards a desired end point. All of the equipment in the process may exhaust into one local exhaust or control system.

d. Location of Equipment, Plant Layout and Flow Charts

The location of the equipment should be indicated under the "Approximate Location on Premises" column of the equipment list. The approximate location can be merely designated according to the position of equipment relative to the front of the plant and the direction north, i.e., as it would appear on a plot plan. Designations may be made as follows: "rear," "front," and "rear-west." In large complex plants with many kinds of sources, these descriptions may not suffice. An equipment location drawing (plot plan) should be prepared on the cross-hatch backing of the equipment list (see Figure 2.7). The plot plan should show clearly the general outline of the plant floor, the intersecting streets around the plant, the departmental organization, and the location of each specific piece of basic and control equipment. Where the industrial plant has multiple stores and the equipment is interconnected by means of blower and duct systems, each floor plan should be shown.

In the case of complicated process units, a flow chart showing the flow of materials through a production sequence should be prepared for clarification. In general, both the process flow drawings and the plant layout are carefully drawn sketches rather than accurately scaled engineering drawings.

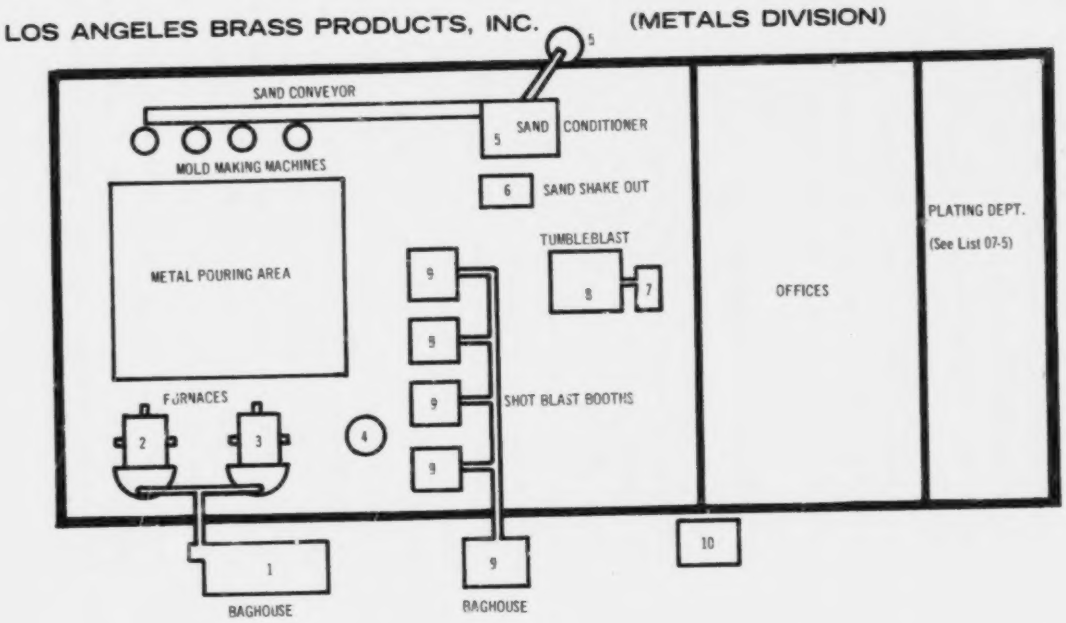

LOS ANGELES BRASS PRODUCTS, INC.
(METALS DIVISION)
5
SAND CONVEYOR
SAND
5
CONDITIONER
MOLD MAKING MACHINES
6
SAND SHAKE OUT
METAL POURING AREA
TUMBLEBLAST
8
7
9
9
9
9
SHOT BLAST BOOTHS
FURNACES
2
3
4
OFFICES
PLATING DEPT.
(See List 07-5)
1
BAGHOUSE
9
BAGHOUSE
10

Figure 2.7. PLOT PLAN ON REVERSE OF EQUIPMENT LIST TO ILLUSTRATE POSITIONING OF EQUIPMENT

(SOURCE: WEISBURD, Reference 3)

Flow diagrams and plot plans are of particular importance in accounting for all equipment in a production sequence which otherwise might be overlooked. They are of value in showing the potential of an existing production system for growth or change. They also show the capacity for such systems to accommodate increased production. Comparison of existing conditions at the time of an inventory reinspection with the flow chart and plot plans made on a previous inventory inspection show exactly how the process may have changed.

e. Determining Permit Status

The factors affecting the permit status are (1) new construction of equipment, (2) change of ownership, (3) change in address-location and (4) alteration of equipment. The equipment list is constructed to provide reference data which will enable enforcement officers on subsequent inventory reinspections to determine whether or not the permit status has changed. For (1) above, any equipment found in the plant capable of air pollution, but not listed on the previous equipment list, will require a permit. For (2) above, change of ownership, any change in the ownership as indicated on the heading of the equipment list, affects the permit status of all equipment in the plant. A new equipment list is then required for the new owner or lessee, who is required to apply for permits for all of the equipment capable of air pollution in the plant. The equipment list of the older, defunct company is stricken from the files by means of a status report. Similarly a change in address-location, (3) above, also requires that applications be made for all of the equipment in the plant.

In the case of (4) above, alteration is frequently determined either by a change which has taken place in the equipment description, or the flow chart, or by changes noted with reference to engineering applications in the permit file.

C. Compliance Plan Status Inspections

Air pollution control agencies in the early stages of their development and those that do not employ permit systems may employ a combination of negotiated compliance plan and code enforcement procedures. Compliance plans may be the result of administrative orders or court or hearing board actions. Once such plans are negotiated, their implementation is subject to verification by inspection.

Compliance plans provide time for compliance with either existing or new rules. A source reduction plan is prepared by the source and negotiated with the enforcement agency, a hearing board or the courts. The time schedule is the enforceable feature of the plan. The compliance plan approach is particularly taken where important questions of technological and economic feasibility are involved. The milestones of the schedule may include:

(1) Completion of engineering evaluations.

(2) Completion of plans and equipment design.

(3) Completion of equipment procurement.

(4) Completion of equipment fabrication.

(5) Completion of equipment installation, modification and adjustment.

(6) Completion of testing and start-up of equipment.

A negotiated compliance plan may call for the submission of written progress reports. Some compliance programs may call for the review of construction plans, as in the permit system, with or without the authority to approve or deny the plans.

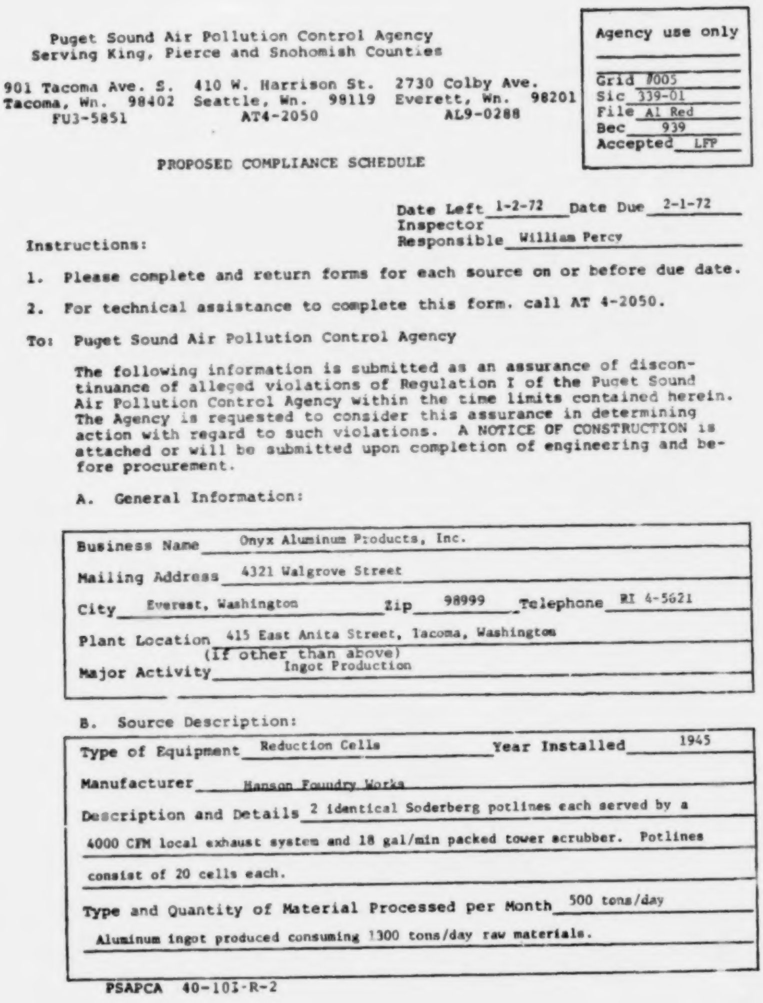
Engineering studies and plans should be subject to review by the agency. Facility inspections assure that plans are submitted as required by any order and deadline, and that scheduled milestones are met. The enforcement officer is also present during any source tests or start-up of equipment. His reports will generally describe the status of construction and statements made by management with regard to problems encountered. Example of a format for a compliance schedule is shown in Figure 2.8.

D. Inspections Relating to Emergencies

Emergencies are of two types: (1) local emergencies--incidents involving the untoward release of contaminants that may be toxic or have the potential for other undesirable health or environmental effects and (2) air pollution episodes in which the buildup of contaminants in the atmosphere approaches or exceeds predetermined alert stages and which may necessitate the curtailment or shutdown of source activities on a large scale. These conditions will require swift response on the part of enforcement officers and performance of special inspections.

1. Local Emergencies

Local emergencies may be observed during field patrol, may occur as a result of citizens complaints or result from reported breakdowns of equipment. Examples of these emergencies include emergency dumping of ammonia from commercial refrigeration systems; explosions from a chlorine manufacturing plant;



Puget Sound Air Pollution Control Agency
Serving King, Pierce and Snohomish Counties

901 Tacoma Ave. S.
Tacoma, Wn. 98402
FU3-5851

410 W. Harrison St.
Seattle, Wn. 98119
AT4-2050

2730 Colby Ave.
Everett, Wn. 98201
AL9-0288

Agency use only
Grid 0005
Sic 339-01
File Al Red
Bec 939
Accepted LFP

PROPOSED COMPLIANCE SCHEDULE

Date Left 1-2-72 Date Due 2-1-72
Inspector Responsible William Percy

Instructions:

1. Please complete and return forms for each source on or before due date.
2. For technical assistance to complete this form. call AT 4-2050.

To: Puget Sound Air Pollution Control Agency

The following information is submitted as an assurance of discontinuance of alleged violations of Regulation I of the Puget Sound Air Pollution Control Agency within the time limits contained herein. The Agency is requested to consider this assurance in determining action with regard to such violations. A NOTICE OF CONSTRUCTION is attached or will be submitted upon completion of engineering and before procurement.

A. General Information:

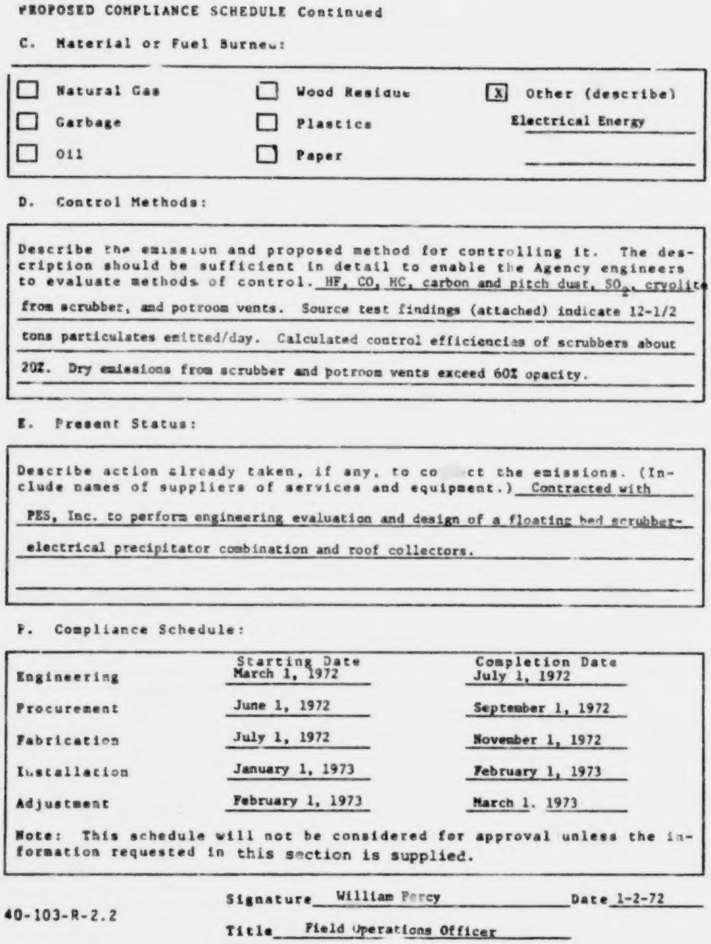
Business Name Onyx Aluminum Products, Inc.
Mailing Address 4321 Walgrove Street
City Everest, Washington Zip 98999 Telephone RI 4-5621
Plant Location 415 East Anita Street, Tacoma, Washington
(If other than above)
Major Activity Ingot Production

B. Source Description:

Type of Equipment Reduction Cells Year Installed 1945
Manufacturer Hanson Foundry Works
Description and Details 2 identical Soderberg potlines each served by a 4000 CFM local exhaust system and 18 gal/min packed tower scrubber. Potlines consist of 20 cells each.
Type and Quantity of Material Processed per Month 500 tons/day
Aluminum ingot produced consuming 1300 tons/day raw materials.

PSAPCA 40-101-R-2

Figure 2.8. PROPOSED COMPLIANCE SCHEDULE FORMAT, PUGET SOUND AIR POLLUTION CONTROL AGENCY (Courtesy Puget Sound Air Pollution Control Agency)



PROPOSED COMPLIANCE SCHEDULE Continued

C. Material or Fuel Burned:

☐ Natural Gas ☐ Wood Residue ☒ Other (describe) Electrical Energy

☐ Garbage ☐ Plastics

☐ Oil ☐ Paper

D. Control Methods:

Describe the emission and proposed method for controlling it. The description should be sufficient in detail to enable the Agency engineers to evaluate methods of control. HF, CO, HC, carbon and pitch dust, SO_2, cryolite from scrubber, and potroom vents. Source test findings (attached) indicate 12-1/2 tons particulates emitted/day. Calculated control efficiencies of scrubbers about 20%. Dry emissions from scrubber and potroom vents exceed 60% opacity.

E. Present Status:

Describe action already taken, if any, to correct the emissions. (Include names of suppliers of services and equipment.) Contracted with PES, Inc. to perform engineering evaluation and design of a floating bed scrubber-electrical precipitator combination and roof collectors.

F. Compliance Schedule:

	Starting Date	Completion Date
Engineering	March 1, 1972	July 1, 1972
Procurement	June 1, 1972	September 1, 1972
Fabrication	July 1, 1972	November 1, 1972
Installation	January 1, 1973	February 1, 1973
Adjustment	February 1, 1973	March 1, 1973

Note: This schedule will not be considered for approval unless the information requested in this section is supplied.

40-103-R-2.2

Signature William Percy Date 1-2-72

Title Field Operations Officer

Figure 2.8. PROPOSED COMPLIANCE SCHEDULE FORMAT, PUGET SOUND AIR POLLUTION CONTROL AGENCY (continued)

accidental emissions of poisonous gases or fumes such as phosgene, hydrogen cyanide, etc.; refinery breakdowns and fires; the spread of noxious or malodorous gases; radiation accidents.

Equipment which can be used in the field include explosimeters, geiger counters, test papers, tutweiler apparatus, midget impingers, gas absorption cells, halide leak detectors, sling psychrometers, etc. (see Chapter 5). The effective use of this equipment and interpretation of results is open to question and depends on the training of field enforcement personnel. Far more reliance should be placed on the field enforcement officer's advanced knowledge of the source and the properties of the toxic gases that may be involved. He should know whether potential hazards to life or health exist in the plant. Benefit of the doubt should be given to the possibility of a hazard and appropriate assistance should be sought from health, fire or police authorities. A full report of any incident should be made including any determination as to whether it was due to accidental or deliberate causes. Industries which have a potential to create hazards to health under accidental or abnormal conditions should be required to install and continuously maintain source monitors.

2. Episode Management

Episode management consists of the following elements:

(1) Industries identified in the emergency prevention plan are required to submit plans for the shutdown or curtailment of emissions during the calling of an alert. Certain specified industrial plants may be required to install radio receiving equipment with decoding devices capable of receiving broadcasts from the enforcement agency of the declarations of alerts, emergencies and information and instructions.

(2) An integral part of episode management is a region-wide air monitoring network and the ability to conduct mobile sampling, to obtain meteorological data and to make forecasts.

(3) A rapid alert or episode notification system that involves police authorities, highway patrols, public officials, safety personnel, defense personnel and the general public may be required. Communications may be by landline, radio, television and teletype. The notification procedure should be planned so that all parties are notified within less than two minutes.

(4) Deployment and direction of all field operation personnel by means of a radio communications system.

In conducting facility inspections, the enforcement officer:

(1) Determines if emergency prevention plans have been submitted, are up-to-date and can be implemented on short notice.

(2) Checks sources of pollution through observation and inspection to see that shutdown plans are being quickly implemented.

(3) Cites all violations of the rules and regulations as well as pertinent provisions of the emergency regulations. All open burning and incineration should be curtailed.

(4) Coordinates, as instructed, with other agencies participating in source reduction efforts during the emergency.

V. ENFORCEMENT METHODS AND FORMS

After the field enforcement officer completes his inspection, he reports his findings and makes appropriate recommendations for action on an appropriate report form. Examples of specific actions that might be taken include:

(1) No violation observed at this time, date recommended for next inspection, file report.

(2) Owner requested to submit permit applications by due date, forward report to engineering services.

(3) Supplemental source registration information obtained, information forwarded to evaluation and planning unit.

(4) Specific equipment identified as source of odor complaints, owner made operational changes, date recommended for next inspection.

(5) Facility inspection completed, no violation observed at this time, equipment list attached, date recommended for next inspection.

(6) No violation observed at this time, violation of equipment suspected, surveillance recommended for late afternoon hours.

(7) Violation of grain loading suspected, source tests recommended under specified conditions. Request for source test attached.

(8) Violation observed, notice written and served.

Actions resulting from an inspection thus take two general forms:

(1) No enforcement action, recommendations for further field or administrative action where applicable, scheduling of next inspection, filing of report. Findings and recommendations are reported on an appropriate form of inspection report. These may be of a general report or special report type. Special reports are frequently of the pre-structured blank completion type. Items 1-7 above, for example, are reported on an inspection report.

(2) Enforcement action in the form of administrative, hearing board or court action. A notice of violation, citation or other enforcement instrument is employed, as in item (8) above.

Types of report forms and enforcement methods commonly employed are described in the following sections.

A. The Inspection Report

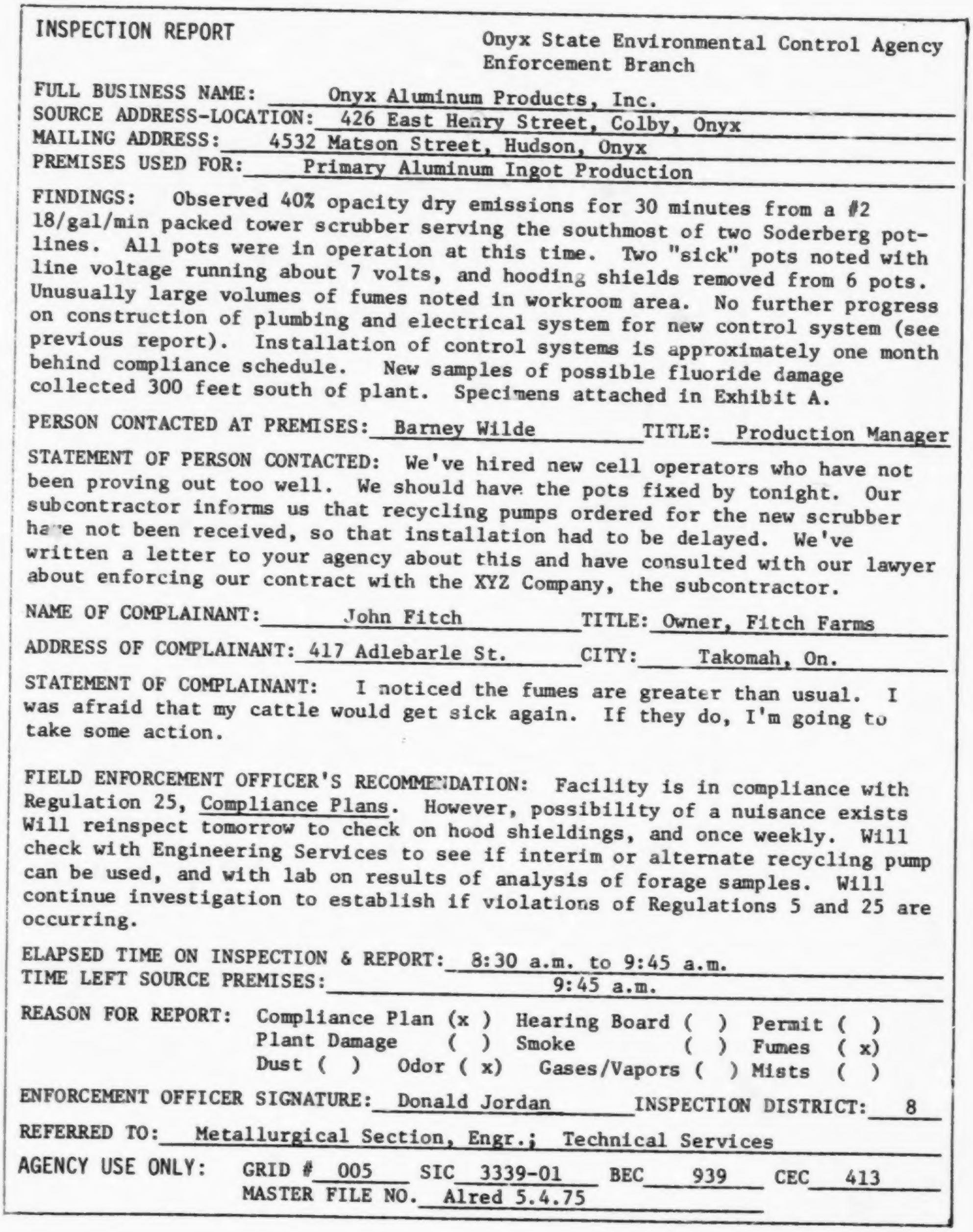
The inspection report is a general report made of the results of an inspection. It does not initiate enforcement action. It develops ownership data, location and identification of the source of air pollution, responsible parties contacted, findings of inspection points checked, recommended action and referral notations. The elements of the narrative type of report are shown in Figure 2.9. When filed, these reports evolve into case histories for use in future enforcement work. Standards of information for inspection reports should therefore be as exacting as those required of violation notices, described below. (See Collecting Evidence, Section IV, Chapter 4.)

Various forms of the inspection report are used (see Figures 2.9 to 2.11) to cover investigations made of complaints, reported breakdowns of equipment, permit-denial and permit follow-up inspections and other situations in which the findings may be briefly reported. Special inspection report forms are also used to report results of specialized inspections such as those made of complicated flows of processes or products, changes in permit status, equipment inventories or compliance plan status.

Some forms of the inspection report may be designed to cover the inspection of just one type of equipment or compliance with a specific rule or regulation of interest (see Figures 2.10 and 2.11). These tend to be mostly of the standardized-blank-completion type.

B. Notice of Violation

A notice of violation is a form completed by the field enforcement officer which notifies an owner or operator or other responsible person that he has violated a specific provision of the rules and regulations through the commission of the acts detailed in the notice. The charge portion usually contains a record of the emissions observed or other elements of the violation (see Collecting Evidence, Section IV, Chapter 4).



INSPECTION REPORT

Onyx State Environmental Control Agency
Enforcement Branch

FULL BUSINESS NAME: Onyx Aluminum Products, Inc.
SOURCE ADDRESS-LOCATION: 426 East Henry Street, Colby, Onyx
MAILING ADDRESS: 4532 Matson Street, Hudson, Onyx
PREMISES USED FOR: Primary Aluminum Ingot Production

FINDINGS: Observed 40% opacity dry emissions for 30 minutes from a #2 18/gal/min packed tower scrubber serving the southmost of two Soderberg potlines. All pots were in operation at this time. Two "sick" pots noted with line voltage running about 7 volts, and hooding shields removed from 6 pots. Unusually large volumes of fumes noted in workroom area. No further progress on construction of plumbing and electrical system for new control system (see previous report). Installation of control systems is approximately one month behind compliance schedule. New samples of possible fluoride damage collected 300 feet south of plant. Specimens attached in Exhibit A.

PERSON CONTACTED AT PREMISES: Barney Wilde TITLE: Production Manager

STATEMENT OF PERSON CONTACTED: We've hired new cell operators who have not been proving out too well. We should have the pots fixed by tonight. Our subcontractor informs us that recycling pumps ordered for the new scrubber have not been received, so that installation had to be delayed. We've written a letter to your agency about this and have consulted with our lawyer about enforcing our contract with the XYZ Company, the subcontractor.

NAME OF COMPLAINANT: John Fitch TITLE: Owner, Fitch Farms

ADDRESS OF COMPLAINANT: 417 Adlebarle St. CITY: Takomah, On.

STATEMENT OF COMPLAINANT: I noticed the fumes are greater than usual. I was afraid that my cattle would get sick again. If they do, I'm going to take some action.

FIELD ENFORCEMENT OFFICER'S RECOMMENDATION: Facility is in compliance with Regulation 25, Compliance Plans. However, possibility of a nuisance exists Will reinspect tomorrow to check on hood shieldings, and once weekly. Will check with Engineering Services to see if interim or alternate recycling pump can be used, and with lab on results of analysis of forage samples. Will continue investigation to establish if violations of Regulations 5 and 25 are occurring.

ELAPSED TIME ON INSPECTION & REPORT: 8:30 a.m. to 9:45 a.m.
TIME LEFT SOURCE PREMISES: 9:45 a.m.

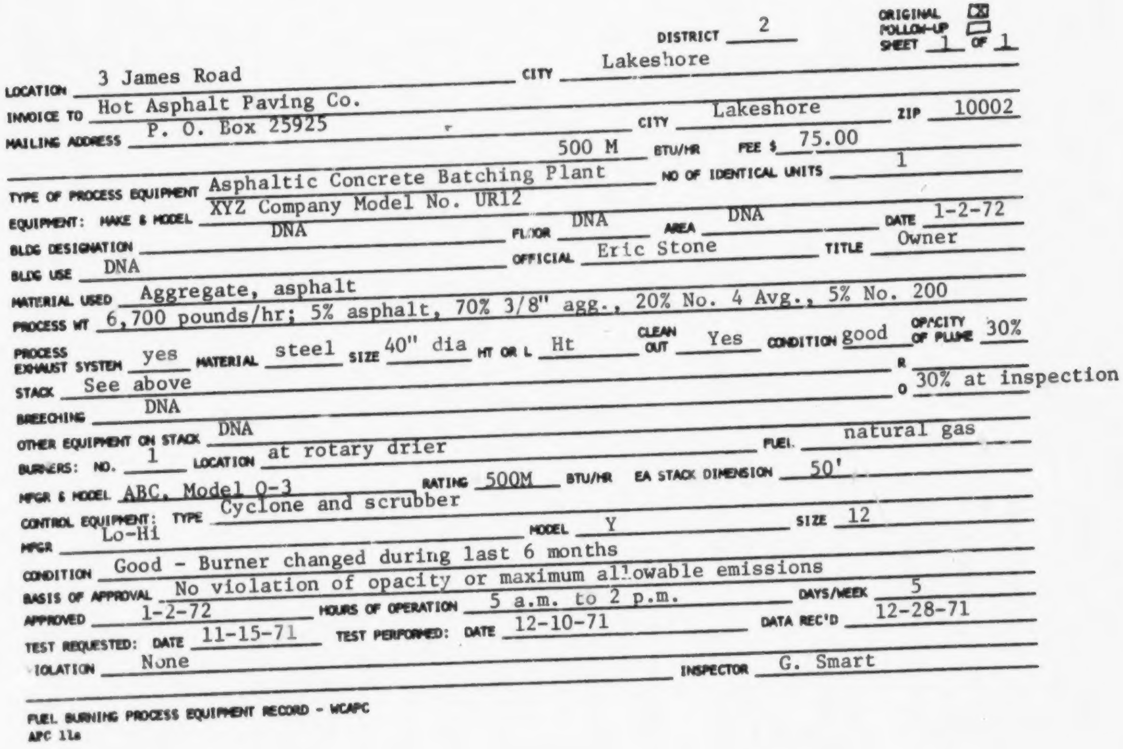
REASON FOR REPORT: Compliance Plan (x) Hearing Board ( ) Permit ( )
Plant Damage ( ) Smoke ( ) Fumes (x)
Dust ( ) Odor (x) Gases/Vapors ( ) Mists ( )

ENFORCEMENT OFFICER SIGNATURE: Donald Jordan INSPECTION DISTRICT: 8

REFERRED TO: Metallurgical Section, Engr.; Technical Services

AGENCY USE ONLY: GRID # 005 SIC 3339-01 BEC 939 CEC 413
MASTER FILE NO. Alred 5.4.75

Figure 2.9. NARRATIVE TYPE OF INSPECTION REPORT



ORIGINAL ☒
FOLLOW-UP ☐
SHEET 1 OF 1

DISTRICT 2

LOCATION 3 James Road CITY Lakeshore

INVOICE TO Hot Asphalt Paving Co.

MAILING ADDRESS P. O. Box 25925 CITY Lakeshore ZIP 10002

500 M BTU/HR FEE $ 75.00

TYPE OF PROCESS EQUIPMENT Asphaltic Concrete Batching Plant NO OF IDENTICAL UNITS 1

EQUIPMENT: MAKE & MODEL XYZ Company Model No. UR12

BLDG DESIGNATION DNA FLOOR DNA AREA DNA DATE 1-2-72

BLDG USE DNA OFFICIAL Eric Stone TITLE Owner

MATERIAL USED Aggregate, asphalt

PROCESS WT 6,700 pounds/hr; 5% asphalt, 70% 3/8" agg., 20% No. 4 Avg., 5% No. 200

PROCESS EXHAUST SYSTEM yes MATERIAL steel SIZE 40" dia HT OR L Ht CLEAN OUT Yes CONDITION good OPACITY OF PLUME 30%

STACK See above R

BREECHING DNA O 30% at inspection

OTHER EQUIPMENT ON STACK DNA

BURNERS: NO. 1 LOCATION at rotary drier FUEL natural gas

MFGR & MODEL ABC, Model 0-3 RATING 500M BTU/HR EA STACK DIMENSION 50'

CONTROL EQUIPMENT: TYPE Cyclone and scrubber

MFGR Lo-Hi MODEL Y SIZE 12

CONDITION Good - Burner changed during last 6 months

BASIS OF APPROVAL No violation of opacity or maximum allowable emissions

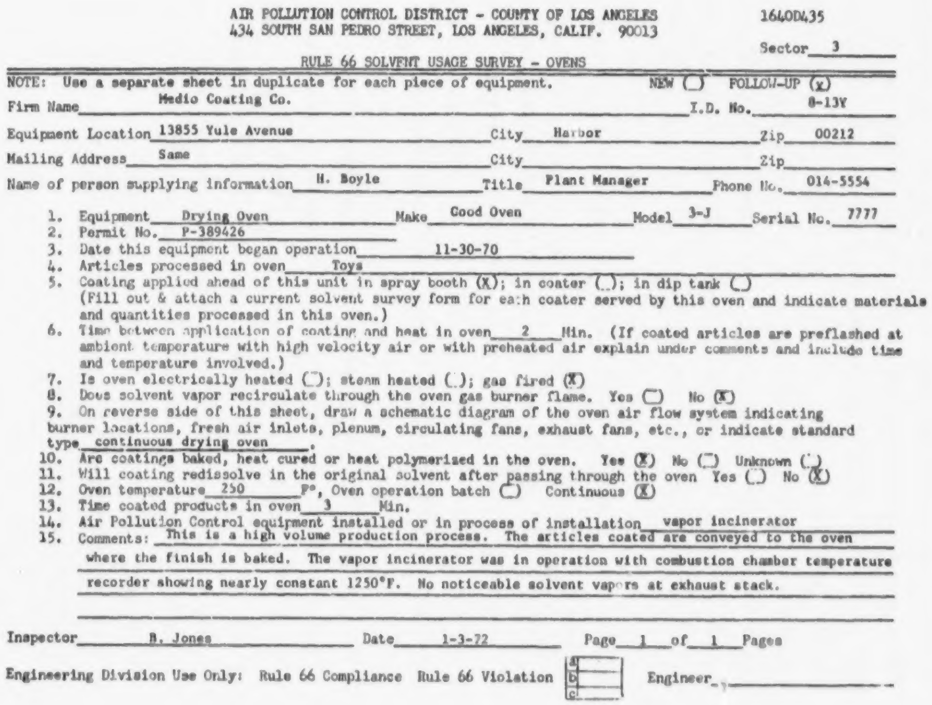
APPROVED 1-2-72 HOURS OF OPERATION 5 a.m. to 2 p.m. DAYS/WEEK 5

TEST REQUESTED: DATE 11-15-71 TEST PERFORMED: DATE 12-10-71 DATA REC'D 12-28-71

VIOLATION None INSPECTOR G. Smart

FUEL BURNING PROCESS EQUIPMENT RECORD - WCAPC
APC 11a

Figure 2.10. EXAMPLE OF INSPECTION REPORT, STRUCTURED FORM, USED FOR GATHERING INFORMATION FOR FUEL BURNING PROCESS EQUIPMENT, WAYNE COUNTY DEPARTMENT OF HEALTH, AIR POLLUTION CONTROL DIVISION



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013

16400435

Sector 3

RULE 66 SOLVENT USAGE SURVEY - OVENS

NOTE: Use a separate sheet in duplicate for each piece of equipment. NEW ☐ FOLLOW-UP ☒

Firm Name Medio Coating Co. I.D. No. 8-13Y

Equipment Location 13855 Yule Avenue City Harbor Zip 00212

Mailing Address Same City Zip

Name of person supplying information H. Boyle Title Plant Manager Phone No. 014-5554

1. Equipment Drying Oven Make Good Oven Model 3-J Serial No. 7777
2. Permit No. P-389426
3. Date this equipment began operation 11-30-70
4. Articles processed in oven Toys
5. Coating applied ahead of this unit in spray booth ☒; in coater ☐; in dip tank ☐
   (Fill out & attach a current solvent survey form for each coater served by this oven and indicate materials and quantities processed in this oven.)
6. Time between application of coating and heat in oven 2 Min. (If coated articles are preflashed at ambient temperature with high velocity air or with preheated air explain under comments and include time and temperature involved.)
7. Is oven electrically heated ☐; steam heated ☐; gas fired ☒
8. Does solvent vapor recirculate through the oven gas burner flame. Yes ☐ No ☒
9. On reverse side of this sheet, draw a schematic diagram of the oven air flow system indicating burner locations, fresh air inlets, plenum, circulating fans, exhaust fans, etc., or indicate standard type continuous drying oven.
10. Are coatings baked, heat cured or heat polymerized in the oven. Yes ☒ No ☐ Unknown ☐
11. Will coating redissolve in the original solvent after passing through the oven Yes ☐ No ☒
12. Oven temperature 250 F°, Oven operation batch ☐ Continuous ☒
13. Time coated products in oven 3 Min.
14. Air Pollution Control equipment installed or in process of installation vapor incinerator
15. Comments: This is a high volume production process. The articles coated are conveyed to the oven where the finish is baked. The vapor incinerator was in operation with combustion chamber temperature recorder showing nearly constant 1250°F. No noticeable solvent vapors at exhaust stack.

Inspector B. Jones Date 1-3-72 Page 1 of 1 Pages

Engineering Division Use Only: Rule 66 Compliance Rule 66 Violation

a	
b	
c	

Engineer

Figure 2.11. EXAMPLE OF INSPECTION REPORT, STRUCTURED FORM, SOLVENT USAGE SURVEY OVENS, LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT

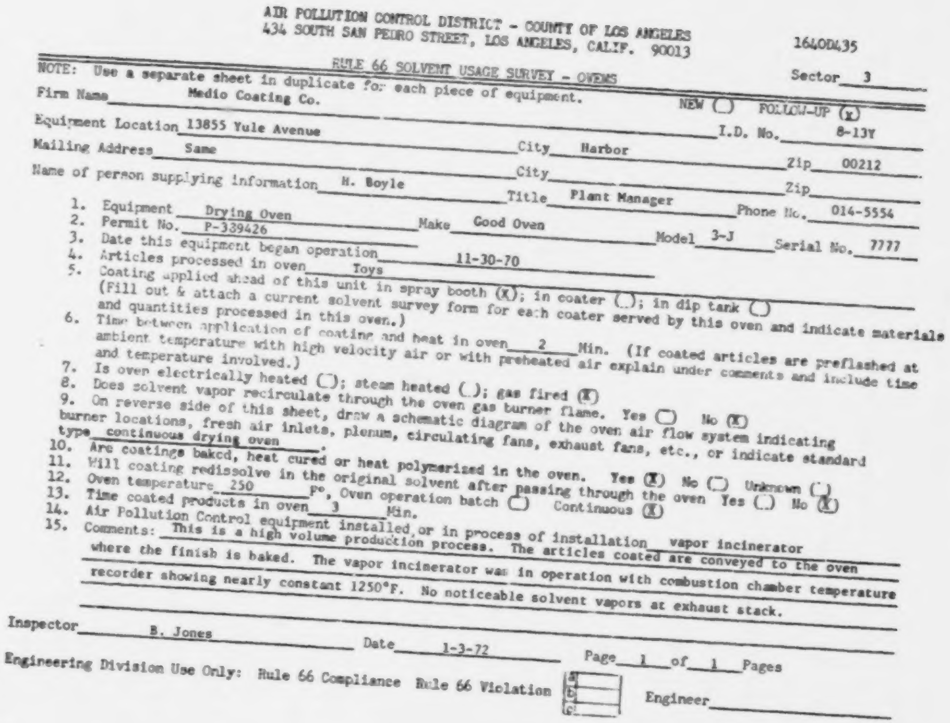
A rigorous description of the facts of the violation is usually supplied on the reverse of the original or separate copy of the notice. The notice may also include a matrix for recording visible emissions as they were read. The charge portion of the notice (minus the inspection report) is served directly to the responsible person on the premises. A copy (or copies) of the notice containing the inspection findings is delivered or sent to the agency and reviewed and processed towards court or other legal action. The violation notice may take two forms; one for stationary sources and one for vehicular sources, as shown in Figures 2.12, 2.12a, 2.12b, 2.12c and 2.13.

Notices are issued only if the field enforcement officer has collected evidence sufficient to prove the occurrence of the violation. The notice deals with facts and avoids presumptive types of information. It should not be issued as a warning or to prescribe remedial action or to order correction of defects. (These actions are usually handled by other inspection procedures.)

Notice forms are usually sequentially numbered and are subject to strict accounting procedures. If the evidence provided by the notice and attached inspection report is sufficient, a complaint can be filed in the appropriate court. If the evidence is incomplete or defective, no action is taken. Where corporations and partnerships and other complex business entities are involved, investigation may be required to establish the chain of authority responsible for the violation. (See Prosecuting Violations, Chapter 3.)

C. The Citation

The citation is similar to the notice in purpose and function with the exception that it cites violators directly to court on a



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013

16400435

RULE 66 SOLVENT USAGE SURVEY - OVENS

Sector 3

NOTE: Use a separate sheet in duplicate for each piece of equipment.

Firm Name Medio Coating Co. NEW ☐ FOLLOW-UP ☒

Equipment Location 13855 Yule Avenue I.D. No. 8-13Y

Mailing Address Same City Harbor Zip 00212

Name of person supplying information H. Boyle City Zip

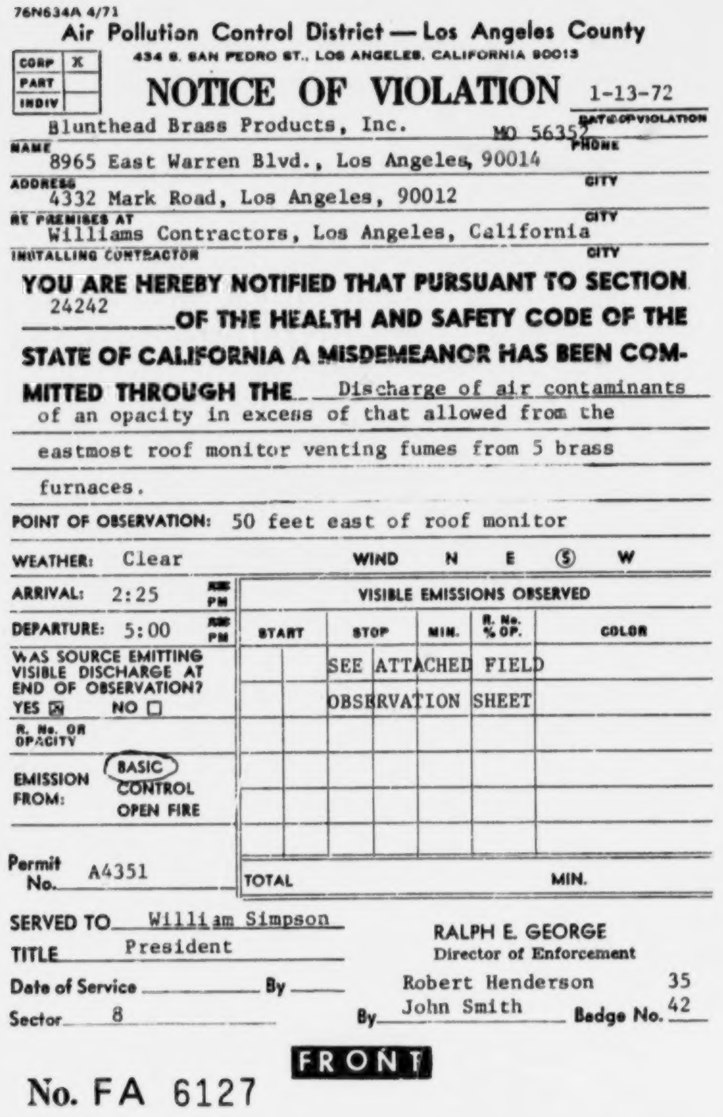
Title Plant Manager Phone No. 014-5554

1. Equipment Drying Oven Make Good Oven
2. Permit No. P-339426 Model 3-J Serial No. 7777
3. Date this equipment began operation 11-30-70
4. Articles processed in oven Toys
5. Coating applied ahead of this unit in spray booth ☒; in coater ☐; in dip tank ☐ (Fill out & attach a current solvent survey form for each coater served by this oven and indicate materials and quantities processed in this oven.)
6. Time between application of coating and heat in oven 2 Min. (If coated articles are preflashed at ambient temperature with high velocity air or with preheated air explain under comments and include time and temperature involved.)
7. Is oven electrically heated ☐; steam heated ☐; gas fired ☒
8. Does solvent vapor recirculate through the oven gas burner flame. Yes ☐ No ☒
9. On reverse side of this sheet, draw a schematic diagram of the oven air flow system indicating burner locations, fresh air inlets, plenum, circulating fans, exhaust fans, etc., or indicate standard type continuous drying oven.
10. Are coatings baked, heat cured or heat polymerized in the oven. Yes ☒ No ☐ Unknown ☐
11. Will coating redissolve in the original solvent after passing through the oven Yes ☐ No ☒
12. Oven temperature 250 F°, Oven operation batch ☐ Continuous ☒
13. Time coated products in oven 3 Min.
14. Air Pollution Control equipment installed or in process of installation vapor incinerator
15. Comments: This is a high volume production process. The articles coated are conveyed to the oven where the finish is baked. The vapor incinerator was in operation with combustion chamber temperature recorder showing nearly constant 1250°F. No noticeable solvent vapors at exhaust stack.

Inspector B. Jones Date 1-3-72 Page 1 of 1 Pages

Engineering Division Use Only: Rule 66 Compliance Rule 66 Violation a ☐ b ☐ c ☐ Engineer

Figure 2.11. EXAMPLE OF INSPECTION REPORT, STRUCTURED FORM, SOLVENT USAGE SURVEY OVENS, LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT



76N634A 4/71

Air Pollution Control District — Los Angeles County

434 S. SAN PEDRO ST., LOS ANGELES, CALIFORNIA 90013

CORP	X
PART	
INDIV	

NOTICE OF VIOLATION 1-13-72

DATE OF VIOLATION

NAME: Blunthead Brass Products, Inc.

PHONE: MO 56352

ADDRESS: 8965 East Warren Blvd., Los Angeles, 90014

CITY

RE PREMISES AT: 4332 Mark Road, Los Angeles, 90012

CITY

INSTALLING CONTRACTOR: Williams Contractors, Los Angeles, California

CITY

YOU ARE HEREBY NOTIFIED THAT PURSUANT TO SECTION 24242 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA A MISDEMEANOR HAS BEEN COMMITTED THROUGH THE Discharge of air contaminants of an opacity in excess of that allowed from the eastmost roof monitor venting fumes from 5 brass furnaces.

POINT OF OBSERVATION: 50 feet east of roof monitor

WEATHER: Clear WIND N E [✓ S] W

ARRIVAL: 2:25 ~~AM~~ PM

DEPARTURE: 5:00 ~~AM~~ PM

WAS SOURCE EMITTING VISIBLE DISCHARGE AT END OF OBSERVATION? YES ☒ NO ☐

R. No. OR OPACITY

EMISSION FROM: [✓ BASIC] CONTROL OPEN FIRE

Permit No. A4351

VISIBLE EMISSIONS OBSERVED

START	STOP	MIN.	R. No. % OP.	COLOR
	SEE ATTACHED FIELD			
	OBSERVATION SHEET			
TOTAL		MIN.		

SERVED TO William Simpson

TITLE President

Date of Service ________ By ____

Sector 8

RALPH E. GEORGE
Director of Enforcement

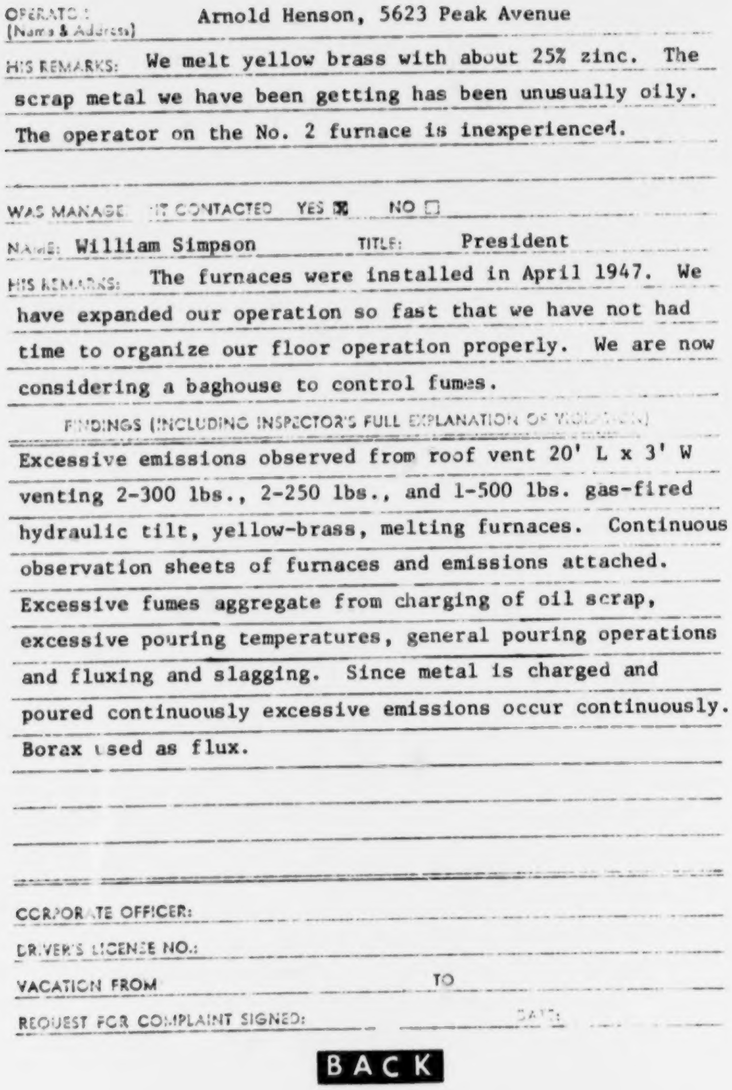
By Robert Henderson Badge No. 35

By John Smith Badge No. 42

FRONT

No. FA 6127

Figure 2.12. NOTICE OF VIOLATION WRITTEM FOR EXCESSIVE FUMES FROM FIVE BRASS FURNACES, FACE SIDE, LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT



OPERATOR: (Name & Address) Arnold Henson, 5623 Peak Avenue

HIS REMARKS: We melt yellow brass with about 25% zinc. The scrap metal we have been getting has been unusually oily. The operator on the No. 2 furnace is inexperienced.

WAS MANAGEMENT CONTACTED YES ☒ NO ☐

NAME: William Simpson TITLE: President

HIS REMARKS: The furnaces were installed in April 1947. We have expanded our operation so fast that we have not had time to organize our floor operation properly. We are now considering a baghouse to control fumes.

FINDINGS (INCLUDING INSPECTOR'S FULL EXPLANATION OF VIOLATION)

Excessive emissions observed from roof vent 20' L x 3' W venting 2-300 lbs., 2-250 lbs., and 1-500 lbs. gas-fired hydraulic tilt, yellow-brass, melting furnaces. Continuous observation sheets of furnaces and emissions attached. Excessive fumes aggregate from charging of oil scrap, excessive pouring temperatures, general pouring operations and fluxing and slagging. Since metal is charged and poured continuously excessive emissions occur continuously. Borax used as flux.

CORPORATE OFFICER:

DRIVER'S LICENSE NO.:

VACATION FROM TO

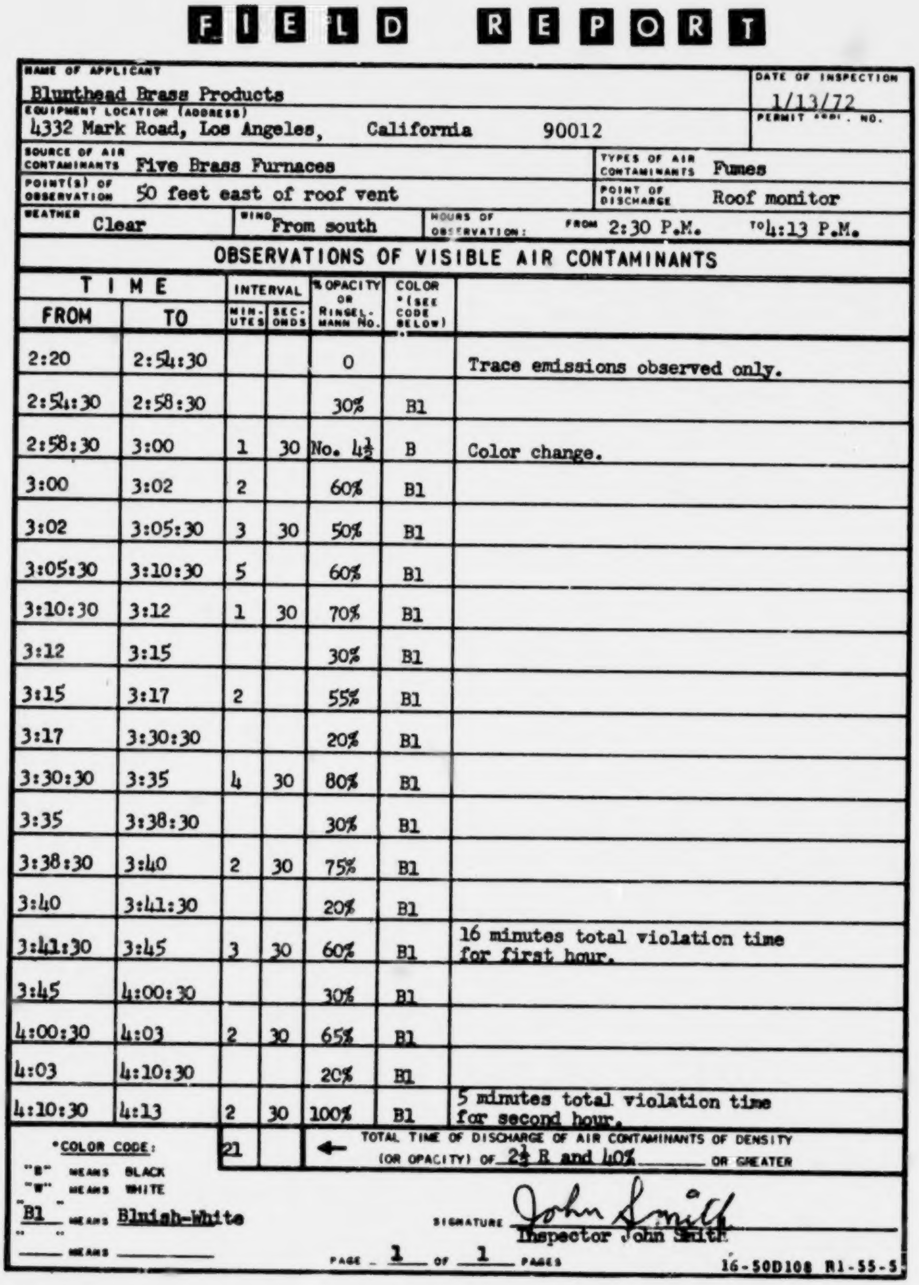
REQUEST FOR COMPLAINT SIGNED: DATE:

BACK

Figure 2.12a. NOTICE OF VIOLATION WRITTEM FOR EXCESSIVE FUMES FROM FIVE BRASS FURNACES, BACK SIDE, LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT

FURNACE NO. FROM EAST TO WEST AND CAPACITY	1 300#	2 300#	3 250#	4 250#	5 500#
Light-off	2:30	2:25	2:20	2:32	2:36
Charge	3:01	2:58	2:54	3:05	3:10
Quantity	40#	50# (oily)	45#	38#	40#
Time	3:25	3:15	3:10	3:30	3:35
Max. Temp.	2225°	2500°	2300°	2230°	2230°
Flux added	3:28	3:18	3:13	3:33	3:38
Slagging	3:30	3:27	3:16	3:45	3:50
Pouring	3:41	3:38	3:30	4:00	4:10

Figure 2.12b. CONTINUOUS OBSERVATION SHEET FOR FIVE BRASS FURNACES SUPPORTING VIOLATION NOTICE FA6127 (Figure 2.12)



FIELD REPORT

NAME OF APPLICANT: Blunthead Brass Products	DATE OF INSPECTION: 1/13/72
EQUIPMENT LOCATION (ADDRESS): 4332 Mark Road, Los Angeles, California 90012	PERMIT APPL. NO.:
SOURCE OF AIR CONTAMINANTS: Five Brass Furnaces	TYPES OF AIR CONTAMINANTS: Fumes
POINT(S) OF OBSERVATION: 50 feet east of roof vent	POINT OF DISCHARGE: Roof monitor

WEATHER: Clear
WIND: From south
HOURS OF OBSERVATION: FROM 2:30 P.M. TO 4:13 P.M.

OBSERVATIONS OF VISIBLE AIR CONTAMINANTS

TIME		INTERVAL		% OPACITY OR RINGELMANN No.	COLOR *(SEE CODE BELOW)	
FROM	TO	MINUTES	SECONDS			
2:20	2:54:30			0		Trace emissions observed only.
2:54:30	2:58:30			30%	Bl	
2:58:30	3:00	1	30	No. 4½	B	Color change.
3:00	3:02	2		60%	Bl	
3:02	3:05:30	3	30	50%	Bl	
3:05:30	3:10:30	5		60%	Bl	
3:10:30	3:12	1	30	70%	Bl	
3:12	3:15			30%	Bl	
3:15	3:17	2		55%	Bl	
3:17	3:30:30			20%	Bl	
3:30:30	3:35	4	30	80%	Bl	
3:35	3:38:30			30%	Bl	
3:38:30	3:40	2	30	75%	Bl	
3:40	3:41:30			20%	Bl	
3:41:30	3:45	3	30	60%	Bl	16 minutes total violation time for first hour.
3:45	4:00:30			30%	Bl	
4:00:30	4:03	2	30	65%	Bl	
4:03	4:10:30			20%	Bl	
4:10:30	4:13	2	30	100%	Bl	5 minutes total violation time for second hour.
		21		← TOTAL TIME OF DISCHARGE OF AIR CONTAMINANTS OF DENSITY (OR OPACITY) OF 2½ R and 40% OR GREATER		

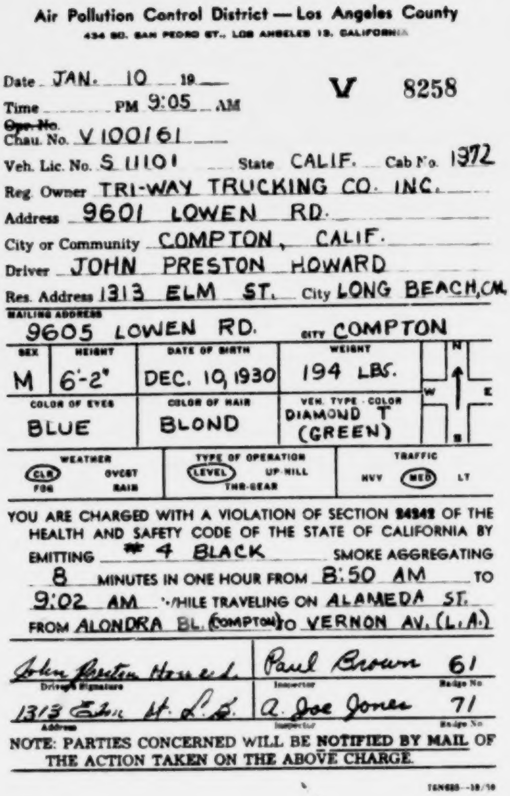
*COLOR CODE:
"B" MEANS BLACK
"W" MEANS WHITE
"Bl" MEANS Bluish-White
"___" MEANS ___

SIGNATURE John Smith
Inspector John Smith

PAGE 1 OF 1 PAGES

16-50D108 R1-55-5

Figure 2.12c. SUPPORTING EMISSION OBSERVATION SHEET TO THE NOTICE OF VIOLATION, Figure 2.12



Air Pollution Control District — Los Angeles County
434 SO. SAN PEDRO ST., LOS ANGELES 12, CALIFORNIA

Date JAN. 10 19__ **V** 8258
Time ____ PM 9:05 AM
~~Opr. No.~~
Chau. No. V 100161
Veh. Lic. No. S 11101 State CALIF. Cab No. 1372
Reg. Owner TRI-WAY TRUCKING CO. INC.
Address 9601 LOWEN RD.
City or Community COMPTON, CALIF.
Driver JOHN PRESTON HOWARD
Res. Address 1313 ELM ST. City LONG BEACH, CAL.
MAILING ADDRESS 9605 LOWEN RD. CITY COMPTON

SEX	HEIGHT	DATE OF BIRTH	WEIGHT
M	6'-2"	DEC. 10, 1930	194 LBS.

COLOR OF EYES	COLOR OF HAIR	VEH. TYPE - COLOR
BLUE	BLOND	DIAMOND T (GREEN)

WEATHER	TYPE OF OPERATION	TRAFFIC
[✓ CLR] OVCST FOG RAIN	[✓ LEVEL] UP-HILL THR-GEAR	HVY [✓ MED] LT

YOU ARE CHARGED WITH A VIOLATION OF SECTION 24242 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA BY EMITTING # 4 BLACK SMOKE AGGREGATING 8 MINUTES IN ONE HOUR FROM 8:50 AM TO 9:02 AM WHILE TRAVELING ON ALAMEDA ST. FROM ALONDRA BL. (COMPTON) TO VERNON AV. (L.A.)

John Preston Howard
Driver's Signature

Paul Brown 61
Inspector Badge No

1313 Elm St. L.B.
Address

A. Joe Jones 71
Inspector Badge No

NOTE: PARTIES CONCERNED WILL BE NOTIFIED BY MAIL OF THE ACTION TAKEN ON THE ABOVE CHARGE.

Figure 2.13. VEHICLE NOTICE

specified date similar to procedures followed in handling traffic citations or tickets.

The citations are generally limited to sources in which the elements and responsibility for commission of the violation are relatively easy to standardize and process. Citations have been used to handle smoke violations for motor vehicle exhausts (see Figure 2.14). They are beginning to be used for certain types of stationary sources, i.e., incinerators.

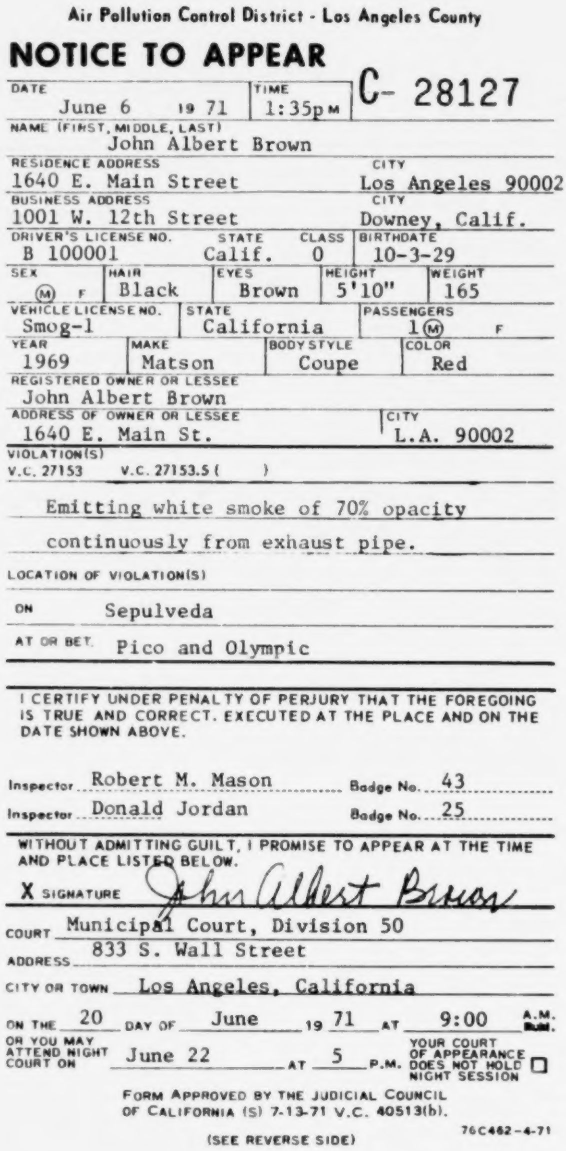
The citation is usually rendered in multiple copies. For example, the first copy may serve as the court complaint, the second is reviewed and filed for the record, the third is the violator's copy and the fourth is retained in the citation book to refresh the field enforcement officer's memory, should he be required to appear in court.

D. Defect Notice Follow-up System

Some agencies employ a defect inspection system which uses a check-off form containing a classification of possible defects, such as those shown in Tables 2.3 and 2.4. Detection of a major defect in a plant results in an order to correct the defect and in withholding renewal of the annual certificates of operation until such correction is made. A minor defect results in a recommendation for correction.(1)

E. Sealing of Equipment

Authority to seal equipment and thus prevent its use and continued violation of emission regulations can be an effective enforcement tool. Application of this punitive and preventive power can be more damaging than fines levied by a court. This procedure is often



Air Pollution Control District - Los Angeles County

NOTICE TO APPEAR

C- 28127

DATE June 6 19 71 | TIME 1:35pM

NAME (FIRST, MIDDLE, LAST) John Albert Brown

RESIDENCE ADDRESS 1640 E. Main Street | CITY Los Angeles 90002

BUSINESS ADDRESS 1001 W. 12th Street | CITY Downey, Calif.

DRIVER'S LICENSE NO. B 100001 | STATE Calif. | CLASS 0 | BIRTHDATE 10-3-29

SEX [✓ M] F | HAIR Black | EYES Brown | HEIGHT 5'10" | WEIGHT 165

VEHICLE LICENSE NO. Smog-1 | STATE California | PASSENGERS 1 [✓ M] F

YEAR 1969 | MAKE Matson | BODY STYLE Coupe | COLOR Red

REGISTERED OWNER OR LESSEE John Albert Brown

ADDRESS OF OWNER OR LESSEE 1640 E. Main St. | CITY L.A. 90002

VIOLATION(S)
V.C. 27153 V.C. 27153.5 ( )

Emitting white smoke of 70% opacity

continuously from exhaust pipe.

LOCATION OF VIOLATION(S)

ON Sepulveda

AT OR BET. Pico and Olympic

I CERTIFY UNDER PENALTY OF PERJURY THAT THE FOREGOING IS TRUE AND CORRECT. EXECUTED AT THE PLACE AND ON THE DATE SHOWN ABOVE.

Inspector Robert M. Mason Badge No. 43

Inspector Donald Jordan Badge No. 25

WITHOUT ADMITTING GUILT, I PROMISE TO APPEAR AT THE TIME AND PLACE LISTED BELOW.

X SIGNATURE John Albert Brown

COURT Municipal Court, Division 50

ADDRESS 833 S. Wall Street

CITY OR TOWN Los Angeles, California

ON THE 20 DAY OF June 19 71 AT 9:00 A.M. ~~P.M.~~

OR YOU MAY ATTEND NIGHT COURT ON June 22 AT 5 P.M. YOUR COURT OF APPEARANCE DOES NOT HOLD NIGHT SESSION ☐

FORM APPROVED BY THE JUDICIAL COUNCIL OF CALIFORNIA (S) 7-13-71 V.C. 40513(b).

76C462-4-71

(SEE REVERSE SIDE)

Figure 2.14. APCD VEHICLE CITATION QUADRUPLICATE

Table 2.3. CODE OF CAUSES OF SMOKE VIOLATIONS

Improper Operation

1. Rodding fire (S)*
2. Firing by hand (S)
3. Air-fuel ratio out of adjustment (S)
4. Not using steam air jets (H)
5. Careless firing (S & H)
6. Starting fire in cold boiler (H & S)
7. Cleaning fire (H & S)
8. Banking fire (H & S)
9. Burning trash (H & S)
10. No one assigned to firing job (H & S)
11. Fireman doing other work
12. Regular fireman off—Relief man firing
13. Other

Improper Equipment

30. Emergency breakdown or service (S)
31. Overfire air needed (S)
32. Overfire air system not effective (S)
33. Equipment dirty (H & S)
34. Equipment in disrepair (H & S)
35. Equipment too small or improper design (H & S)
36. Insufficient draft (H & S)
37. No smoke indicator
38. Smoke indicator not effective
39. Other

Improper Fuel

60. Using high volatile coal without proper equipment (H)
61. Fuel too large—Not enough slack (S)
62. Fuel too small—too much slack
63. Bad load of coal—general
64. Other

Miscellaneous

90. Unable to determine cause (H & S)
91. Junk fire
92. Incinerator
93. Other

*See Table 2.4.

Table 2.4. STANDARD ABBREVIATIONS

A. Action

RB = Report back
NTA = Notice to appear

B. Equipment

PR = Power or process
H = Heating
WAF = Warm air furnace
S = Stoker
HF = Hand-fired
OB = Oil burner
PF = Powdered fuel
W = Wood

(SOURCE: Gruber, Reference 1)

applied to ensure correction of defects in space heating equipment by sealing units at the end of the heating season. Thus the owner is not deprived of its use when needed but he knows he must get it corrected during warm weather. It is also a useful took in preventing further construction on a unit being built in a manner different from that prescribed in approval plans.(5)

F. Work Reports

The work report or daily report, as it is sometimes called, is a daily record made by the field enforcement officer of all inspection stops and reports made, in chronological order of performance and other field or office work performed (see Figure 2.15).(3)

The daily report is used for review purposes, to check completion of assignments, work efficiency and to tabulate the number of inspections or man-hours spent in the field in the various categories of field duties. The daily report also shows district coverage in terms of areas patrolled, facilities observed and miles driven.

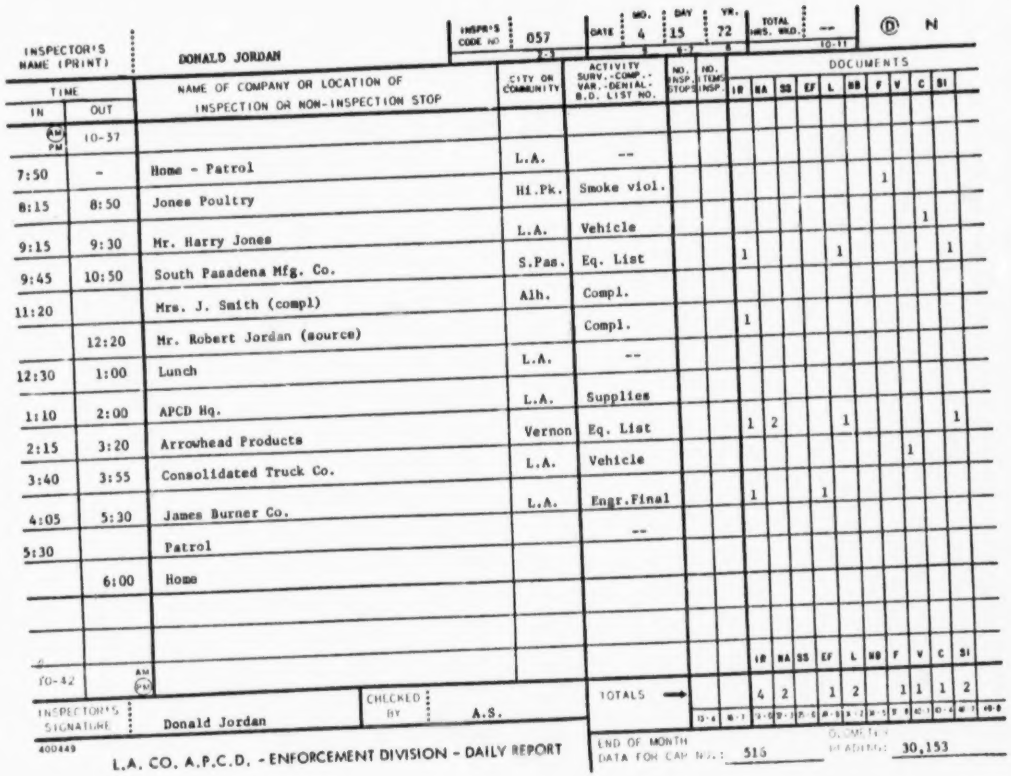
VI. PROCESSING OF REPORTS

The review process is intended to maximize and validate the data and evidence collected by enforcement officers since important legal use may be made of this information at any time.

All of the reports, together with the daily report, are assembled usually by an enforcement supervisor for review, correction and disposition. The supervisor performs the following:

(1) Checks for accuracy, completeness of data or evidence of violation.

(2) Corrects or returns reports to enforcement officers and instructs or trains the officers accordingly.



INSPECTOR'S NAME (PRINT): DONALD JORDAN
INSP'R'S CODE NO: 057
DATE: MO. 4 DAY 15 YR. 72
TOTAL HRS. WKD.: --
Ⓓ N

TIME IN	TIME OUT	NAME OF COMPANY OR LOCATION OF INSPECTION OR NON-INSPECTION STOP	CITY OR COMMUNITY	ACTIVITY SURV.-COMP.-VAR.-DENIAL-B.D. LIST NO.	NO. INSP. STOPS	NO. ITEMS INSP.	IR	NA	SS	EF	L	NB	F	V	C	SI
[✓ AM] PM	10-37															
7:50	-	Home - Patrol	L.A.	--												
8:15	8:50	Jones Poultry	Hi.Pk.	Smoke viol.									1			
9:15	9:30	Mr. Harry Jones	L.A.	Vehicle											1	
9:45	10:50	South Pasadena Mfg. Co.	S.Pas.	Eq. List			1				1					1
11:20		Mrs. J. Smith (compl)	Alh.	Compl.												
	12:20	Mr. Robert Jordan (source)		Compl.			1									
12:30	1:00	Lunch	L.A.	--												
1:10	2:00	APCD Hq.	L.A.	Supplies												
2:15	3:20	Arrowhead Products	Vernon	Eq. List			1	2			1					1
3:40	3:55	Consolidated Truck Co.	L.A.	Vehicle										1		
4:05	5:30	James Burner Co.	L.A.	Engr.Final			1			1						
5:30		Patrol		--												
	6:00	Home														
10-42	AM [✓ PM]						IR	NA	SS	EF	L	NB	F	V	C	SI
				TOTALS →			4	2		1	2		1	1	1	2

INSPECTOR'S SIGNATURE: Donald Jordan
CHECKED BY: A.S.
400449
L.A. CO. A.P.C.D. - ENFORCEMENT DIVISION - DAILY REPORT
END OF MONTH DATA FOR CAR NO.: 516
ODOMETER READING: 30,153

Figure 2.15. ENFORCEMENT OFFICER'S DAILY REPORT, LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT (Codes: IR=Inspector's Report, NA=Notice to Apply, SS=Solvent Survey, EF=Engineering Final, L=Equipment List, F=Stationary Source Notice, V=Vehicle Notice, CV=Commercial Vehicle, C=Citation, Passenger Vehicle, SI=Visual Observations for Possible Emissions.)

(3) Checks the completion of all assigned inspections.

(4) Approves or establishes reinspection schedule.

(5) Refers report and/or supplies coding for computer processing.

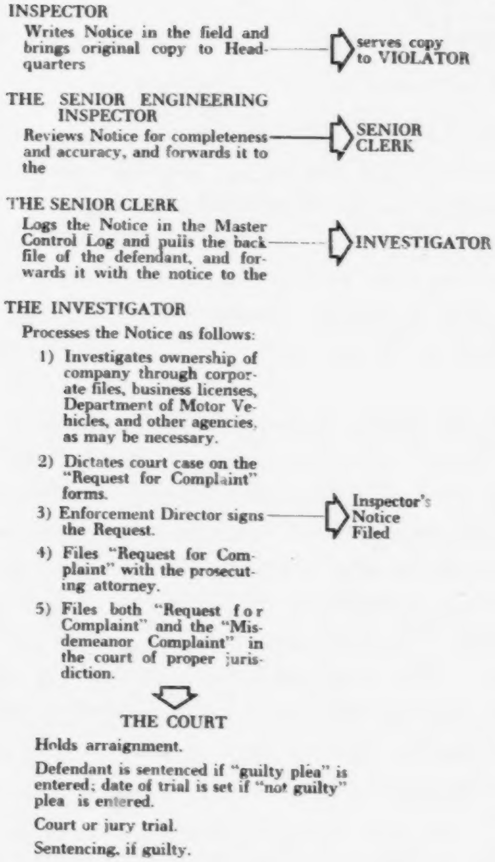
(6) Files report or takes other action.

Reports should be carefully checked, especially for completeness of the specific facts of the violation: the names and addresses of responsible parties, opacity and Ringelmann values and time intervals of violations, as well as a record of all persons involved. In permit cases, an accurate and specific description of status and such facts as degree of alteration or modification, date of change of ownership, relocation of equipment and exemptions, should be accurately ascertained and described.

The disposition of most reports is predetermined since routine processing is set up for each report. The action to be taken is initiated by the enforcement officer. The review process is concerned with confirming, or correcting, his judgment. If the field enforcement officer observes a violation and is able to collect the necessary evidence, then he must write a notice or citation, whichever is the case. If the notice is valid, it should be processed towards legal action. If the field enforcement officer does not observe a violation, or he is unable to gather the necessary evidence, then he must use the proper form of the inspection report. The function of the report determines the disposition and routing procedure, as follows:

(1) If the report is a citation, notice of violation, or report recommending legal action, it is forwarded to the investigation or legal staff for possible legal action. (See Figure 2.16.)

(2) If the report is a request to apply for permit, or other inspection report covering permit matters, a copy is kept in suspense for follow-up inspection to assure submission of applications and another copy is forwarded to alert engineering services to the forthcoming applications and to provide data essential to permit processing.



INSPECTOR

Writes Notice in the field and brings original copy to Headquarters

THE SENIOR ENGINEERING INSPECTOR

Reviews Notice for completeness and accuracy, and forwards it to the

THE SENIOR CLERK

Logs the Notice in the Master Control Log and pulls the back file of the defendant, and forwards it with the notice to the

THE INVESTIGATOR

Processes the Notice as follows:

1) Investigates ownership of company through corporate files, business licenses, Department of Motor Vehicles, and other agencies, as may be necessary.
2) Dictates court case on the "Request for Complaint" forms.
3) Enforcement Director signs the Request.
4) Files "Request for Complaint" with the prosecuting attorney.
5) Files both "Request for Complaint" and the "Misdemeanor Complaint" in the court of proper jurisdiction.

THE COURT

Holds arraignment.

Defendant is sentenced if "guilty plea" is entered; date of trial is set if "not guilty" plea is entered.

Court or jury trial.

Sentencing, if guilty.

Figure 2.16. PROCESSING OF WRITTEN NOTICES OF VIOLATION

(3) If the report calls for further investigation or surveillance before the matter can be resolved, it is referred to the appropriate district or special enforcement officer.

(4) If the report resulted from an assignment, it is referred to the assignor.

(5) If the report involves a policy decision, it is referred to the appropriate staff member.

(6) If the report requires no further action due to resolution of the problem or lack of evidence, it is filed for reference.

VII. MANAGEMENT OF ENFORCEMENT DATA

The enforcement process, shown in Figure 2.1, by its nature must continuously generate considerable quantities of data on the sources of air pollution. At the same time, it must retrieve and use much of this data in the daily conduct of the field operations and enforcement program. The smooth and effective functioning of the enforcement process thus depends on the flow of information among the various work units. Both record-keeping and data management systems are essential.

(1) Record-Keeping Systems--record keeping maintains original field reports, court and hearing board and other important documents in their original form in the event that legal use may be made of them at any time. They are usually kept in the form of dossiers or case histories, filed by the name of the source and assigned a master record number to permit cross-referencing to other data files and listings.

The record system should provide the capability to retrieve original documents and individual case histories of prior compliance or violation and other factual information which might be submitted as evidence in a court of law, such as:

frequency of violation
causes of pollution problems
emission potentials
process flows
equipment maintenance and operational practices
fuels and materials employed
products manufactured
permit applications received
permits issued
permit denials

The record system also provides information concerning field and administrative practices that can be evaluated from the standpoint of program improvement. Records disclose the judgments, decisions and techniques applied at each processing step and level of responsibility.

(2) Information Management--information management systems provide two broad types of functions: (a) information management itself--input, storage, maintenance and output of information required by enforcement personnel; (b) summaries of information needed in the management, planning and evaluation of the enforcement program (management information). Inspection and enforcement reports provide the data elements which, when extracted and structured into a data base, are available for selective retrieval, listings, generation of management reports, data conversion and statistical analysis.

Management information is of particular importance to the direction of the enforcement program. It is needed for the purposes of:

(1) Work scheduling and work load balancing.

(2) Evaluation of performance with respect to the assigned enforcement mission.

(3) Evaluation of performance with respect to air quality goals and control strategies.

Management information of types (1) and (2) above provide information on categories of work performed by enforcement personnel such as the number of firms inspected, notices written, and complaint investigations conducted, and schedules much of this work. This information is routinely generated in periodic and summary report form by many air pollution control agencies.

Management information of type (3) is the type of information that would be generated for the air pollution control officer and his staff which relates enforcement activities to changes in calculated emission rates by grid squares in the control jurisdiction and hence to changes in air quality. Output of this type requires the use of sophisticated computer software in order to integrate the pertinent data processing activities and information flows of the air pollution control agency. This may be accomplished through a highly developed permit system or through an Emission Inventory and Enforcement Management system (EI/EMS), as shown in Figure 2.1.

The function of the latter is to summarize data on emission rates by pollutant classes and grid squares such that estimation of air quality can be made, on the one hand, and the relative contributions of the emission sources to air quality can be assessed on the other. Such systems are at the frontier of the state-of-the-art because of the mathematical modeling and the extensive source and air monitoring required to quantitatively relate changes in emission rates to changes in air quality and enforcement performance. Where permit systems are used, emission rates are calculated and assigned to individual facilities at the time of the processing of the permit. These data are input to the data bases for each grid square.

Work-scheduling, balancing and evaluation must be conducted by all agencies. The following types of management reports are usually required.

(1) Work Accomplishment Reports--these summarize work performed by each enforcement officer, enforcement subunit (industrial, specialized, patrol, etc.) and the enforcement branch as a whole, for each reporting period (monthly, quarterly and annual). This summary information is usually consolidated from the enforcement officers' daily reports, an example of which is shown in Figure 2.15.

(2) Inventory Inspections-Projected Work Load Statistics--this report compares the number of firms and their number of permitted and non-permitted items and associated work units, as stored in the current information management system data base, with a forecast of the number of inspections to be conducted in the next reporting period. The forecast is based on a multiplication of the current inspection frequency assignments times the number of inspection items currently on file. This comparison may be output by grid, sector (or district) or for the entire control jurisdiction. This information is used for adjusting manpower and work assignments and schedules to meet projected equipment inventory requirements.

(3) Inventory Inspections-Accomplished Inspections vs. Scheduled Inspections--this type of report establishes the number of inventory inspections conducted by the number of facilities and the associated number of inspection items and work units in each of 7 inspection frequency categories. These categories include 4 times per year, 3 times per year, 2 times per year, 0 times per year (once every other year), "X," no assignment, but record maintained and "*," low priority equipment to be inspected when manpower is available. Two status categories also include: "non-source" and "out of business." For each of the above categories, current quarterly assignments are compared with inspections performed, and new and past assignments.

(4) Complaint Load Statistics--complaints made to the control agency are also compiled daily, quarterly and annually from message logs and inspection reports. This information will show trends by facility and equipment over periods of time.

(5) Enforcement Statistics--include reports made of numbers of violation notices and citations issued by source category, the number of cases handled by the courts and hearing boards and convictions and penalties assessed.

Filing and retrieval systems may be operated on a manual, semi-automatic or fully automated basis. Except for the dossier files, the total enforcement system, or key or high-use portions of it, can be committed to electronic data processing (EDP). Once such a system is designed, it can be programmed and installed. EDP requirements will depend on the volume of data to be handled by the agency. Actually, some use of EDP should be within reach of all enforcement agencies. Options open are batch, remote batch, time-sharing, general purpose software, combination microfilm/EDP or other manual/EDP combinations. Off-the-shelf software for smaller agencies in batch or time-sharing modes are available.

Data management systems should not be considered as a panacea; they will not fulfill, on demand, any request for information that might be made of them. Output is limited to the functions for which the information system is designed and the scope, format and quality of the input data. Data management systems are thus optimized around one or a small number of basic functions. A system may be oriented to emission inventories, source registration, inspection scheduling, defect correction or management reports.

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3. Weisburd, M. I. Air Pollution Control Field Operations Manual. DHEW, PHS, DAP. P.H.S. No. 937. 1962.

4. Loquercio, P., and W. J. Stanley. Air Pollution Manual of Coding. DHEW, PHS, National Center for Air Pollution Control. 1968.

5. Schueneman, J. J. Air Pollution Control Administration. In: Air Pollution, Vol. III, A. C. Stern (ed.). New York City, Academic Press. 1968.

CHAPTER 3
PROSECUTING VIOLATIONS

I. INTRODUCTION

In the earliest times, remedies against damage from air pollution (at least in Great Britain and the United States) were based on prohibitions against public nuisances. This is a term which describes a miscellaneous group of conditions which cause annoyance, inconvenience, discomfort, damage or harm to the general public.(1) In most countries, such conditions are prohibited and punishable by criminal law. Each case is usually decided on its own merits, but this approach, although still available, has become unwieldy.

Even though under common law, smoke and other contaminants were not considered to be nuisances *per se*, it is now well-established that legislative bodies can declare air contaminants to be a public nuisance. The courts will not invalidate such acts provided that the declaration is reasonably clear and certain.(2) The increasing number of gaseous and particulate substances which may be considered to be pollutants has made this recourse more uncertain because of the difficulty of proof and the complexities of prevention and control associated with the less obvious forms of pollution.

Increased reliance, therefore, is being placed on specific statutes under legislation based upon the police power of the state. This is a power granted under the 10th Amendment to the United States Constitution and which may be conferred upon municipalities by statute or charter.(1) It empowers the state to pass appropriate laws intended to regulate specific conditions which affect the comfort, health, convenience, good order and welfare of the inhabitants.

The landmark case of Northwestern Laundry vs. Des Moines (239 U.S. 486, 1961) confirmed the power of local government to adopt and enforce specific air pollution abatement ordinances. Air pollution statutes thus are in the same category as food adulteration in that they are strict liability offenses; i.e., proof of actual injury to health or property is not necessary to support conviction of violation of the statute.(1,3)

A. Criminal Sanctions

Maintenance of a public nuisance is a crime in most countries and punishable by criminal sanctions. The two common categories of crimes are misdemeanors and felonies. Where violations of public nuisance or other air pollution statutes are declared to be a crime they are inevitably treated as misdemeanors. Misdemeanor penalties may involve both fines and imprisonment with a common maximum penalty being $500 or a year in jail. State prison sentences are not allowed for misdemeanors. It is possible in some states, however, to impose felony penalties on conviction of conspiracy to commit a misdemeanor.

In criminal cases, the defendant has a right to a speedy trial, an attorney and a jury trial. The evidence burden for the prosecution is beyond a reasonable doubt and in the case of a jury trial the jurors must be convinced of this proof although the 5th Amendment protection has been cited as a possible hindrance to prosecution. This practice, however, has not proven to be a problem.(3) The 5th Amendment privilege, also, does not extent to corporations.

The use of criminal laws tends to minimize length of litigation, involves straightforward procedures and utilizes existing legal structures.

B. Civil Procedures

The use of civil procedures to secure enforcement of air pollution statutes serves as an alternative or supplementary approach to that of criminal sanctions in many jurisdictions. The injunction is one of the traditional tools available. It seeks to prevent a future action by a polluter rather than punish a past action. While a very powerful tool, Kennedy(2) suggests that it is the "big gun" to be used mainly when dealing with a large and continuing violation. Also procedures can become very lengthy. Brecher and Nestle(4) state that the courts often assert that a permanent injunction is an extraordinary remedy to be granted sparingly. The courts also "balance the hardships" in injunction cases.

Another civil approach is available when the legislature provides for monetary forfeiture following a determination that an abatement order or regulation has been violated. Some states have provided for very heavy monetary penalties, particularly for violation of an abatement order issued by an air pollution control or hearing board following a hearing. In some states these actions take precedence over many other civil matters and, therefore, the delay in enforcement is minimized.

In civil procedures a person may be required to testify against himself and there is no right to a jury trial. Decisions are based upon the preponderance of evidence. The major types of enforcement procedures, based upon criminal and civil sanctions, are described in the following sections of this chapter.

THE ADMINISTRATIVE HEARING PROCESS

The administrative hearing is a civil procedure wherein an owner of a facility responsible for a violation of the rules and regulations or an air pollution problem requiring abatement is ordered to attend a hearing. Depending on agency practices, the hearing may be conducted by the enforcement agency or a quasi-judicial body appointed by an air pollution commission, board, or equivalent. The hearing may be requested by the agency, or by an owner seeking relief from an order of the agency.

The administrative hearing process is usually employed where the intent of the basic legislation is to exhaust all administrative remedies before taking any case to court. It is particularly suited where strong programs for voluntary compliance are in force. This procedure gives the agency powers to issue cease-and-desist orders, levy fines and negotiate settlements such as source compliance plans and schedules.

This procedure differs from hearing boards of the type described in the next section in that it involves cases (such as code violations) that would not be heard before these boards, and it confers upon the enforcement agency powers that would ordinarily be handled by the courts and hearing boards in criminal actions. It should also be distinguished from informal conferences and meetings, involving participation of the owner, such as those commonly conducted during the processing of permit applications to discuss technical content and standards of judgment.

A possible chain of events where administrative hearing procedures are employed is as follows:

1. The field enforcement officer observes a violation in the field, collects information and informs the highest person in authority at the facility that a violation has occurred. In some of the agencies that use this procedure, violation notices are not served in the field.
2. A copy of the violation notice, signed by the air pollution control officer, is sent to the facility by registered mail.

3. Conferences are held, as required: (a) with responsible representatives of the facility and/or (b) among enforcement agency staff. Decisional options include: (a) no action, (b) return to the field enforcement officer for further investigation or additional information, or (c) prosecution.

4. The air pollution control officer, after considering the case, or as a result of an administrative hearing (below), may issue an abatement order outlining the steps to be taken to attain compliance. This order may be reviewed by a hearing board or hearing master to confirm the order.

5. If a decision is made to process the case towards prosecution, a formal administrative hearing is scheduled at which both parties are allowed to present their positions and evidence. While the testimony taken at any hearing is under oath, the parties are not bound by the strict rules of evidence prevailing in courts of law and equity.

6. Taking into account the history of the plant, the agency and/or hearing board may have the option of ordering correction and/or levying a fine as a settlement in lieu of court action. If an administrative penalty is not paid, the matter is reported to the courts for proper action. If the penalty is paid, and satisfactory compliance is achieved within a prescribed period of time, a portion of the penalty may be rebated to the owner.

7. A first violation may result in the issuance of a cease-and-desist order with a date by which the violation must be corrected.

8. If repeated violations occur, increased administrative penalties are assessed or the case is taken to court.

The administrative hearing approach presents advantages of flexibility in handling each case on its merits, and the capability to achieve compliance on a voluntary basis and to employ legal remedies when required. This procedure can be very time-consuming and require frequent conferences with the industries concerned, thus limiting the number of cases that can be handled at any time. Also, systems which combine judicial and enforcement functions within the same administrative entity may be undesirable. The administrative hearing procedure, however, can be made to work well by applying objective criteria, by court validation and by clear-cut policies favoring uncompromising compliance and speed of action.

III. HEARING BOARDS

Hearing boards are usually quasi-judicial bodies provided for by the basic state acts dealing with air pollution control. In many cases, members are appointed by an air pollution control board or equivalent body at the state, regional or local level but operate at a distinctly different level from the administrative arm of the agency. In a few cases, the air pollution control board may also act as a hearing or appeals body.

Procedures governing the operation of hearing boards may be contained in the state administrative procedures act or may be established by basic air pollution control legislation. These procedures may be quite informal or as formal as those of actual judicial bodies including power of subpoena, provision for cross-examination, and strict rules of evidence. Most often the procedures are intermediate in informality, allowing, for example, the introduction of hearsay evidence. This level of quasi-formality contributes to one of the advantages of a hearing board procedure as compared to a courtroom trial, that is, the relative speed at which issues are decided.

Review by the courts of hearing board actions is generally provided in the basic legislation although the courts do not lightly reverse hearing board decisions.

Hearing boards have a variety of functions depending upon basic legislation and the type of rules and regulations utilized in the control of air pollution. Several of the main functions are discussed below:

A. Variances

Variances are temporary authorizations to discharge air contaminants in excess of the statutory limit. Usually they are issued for periods of time not to exceed a year without additional review and in no case is a public nuisance allowed to exist as a result of a variance. Submission of attainable plans for, or progress towards, controlling the particular air pollution problem is the usual condition for granting a variance.

Hearings on variances are equity proceedings to the extent that private losses are balanced against the public good in each case. A typical case in which a variance might be justified could involve a manufacturing plant employing several hundred people and producing a product sold in a highly competitive market. Air pollution in excess of mass emissions standards is discharged, but no public nuisance appears to exist. The plant has definite attainable plans for installing control equipment, but installation will take 3 months. The plant asks for a variance to operate during this period on the grounds that several hundred people will be put out of work if the facility is forced to close for this period and it may also face the permanent loss of at least a portion of the market for their product. The granting of a variance for a 3-month period on the condition that suitable control equipment be installed would be a likely outcome of such a hearing.

The advantage of hearing board procedures for variances is that the administrative officer does not have to compromise his role as the person responsible for enforcing the rules and regulations. He has little excuse for not acting in a vigorous manner to secure abatement of all air pollution sources. The variance procedure can be abused, of course, if inordinately long periods are authorized in the variance or if variances are renewed on insufficient technical or economic grounds.

B. Appeals of Permit Denial

While a permit system provides the air pollution control officer a great deal of power to take preventive action against emission sources, it also gives him substantial responsibility to exercise this power wisely. It is conceivable that judgmental mistakes of a technical nature may be made by agency engineers reviewing permit applications, particularly authorities to construct. The appeal procedure gives the person seeking to install a process or item of control equipment an avenue of appeal not involving a more costly court procedure if he feels an incorrect decision has been made.

C. Review of Abatement Orders

In those agencies where abatement orders may be issued by the executive head of an air pollution control agency, the hearing board may be authorized or required to review such orders before they can be enforced. In a similar manner, findings of violation by the air pollution control officer may have to be confirmed by a hearing board before court action can be taken.

D. Issuance of Abatement Orders

In some states hearing boards are authorized to issue abatement orders following a hearing requested by the air pollution control officer. This is a highly variable situation at present as air pollution control officers and air pollution control boards are authorized in some jurisdictions to issue such orders.

E. Revocation and Suspension of Permits

Whenever a facility which has been granted a permit develops a history of repeated non-compliance, the air pollution control officer may petition the hearing board for a revocation of the permit.

Permits may also be suspended by the agency if the permittee fails to furnish required information, analyses, plans or specifications. If the permit is suspended, the permittee may petition the hearing board for a public hearing to determine whether or not the permit was properly suspended. The hearing board, accordingly, may reinstate the permit, sustain the suspension or set forth conditions which must be met before reinstatement is granted. The air pollution control officer may reinstate a suspended permit on his own discretion.

IV. THE COURTS

In the case of enforcement agencies that enforce rules and regulations based on criminal sanctions, notices of violation are usually served in the field to the alleged violators and the case is decided in a court of law.

Most air pollution cases are misdemeanor actions and are tried in municipal or justice courts in the locality in which the violation occurred. Cases which are appealed from municipal or justice court decisions may be further heard in an appellate court.

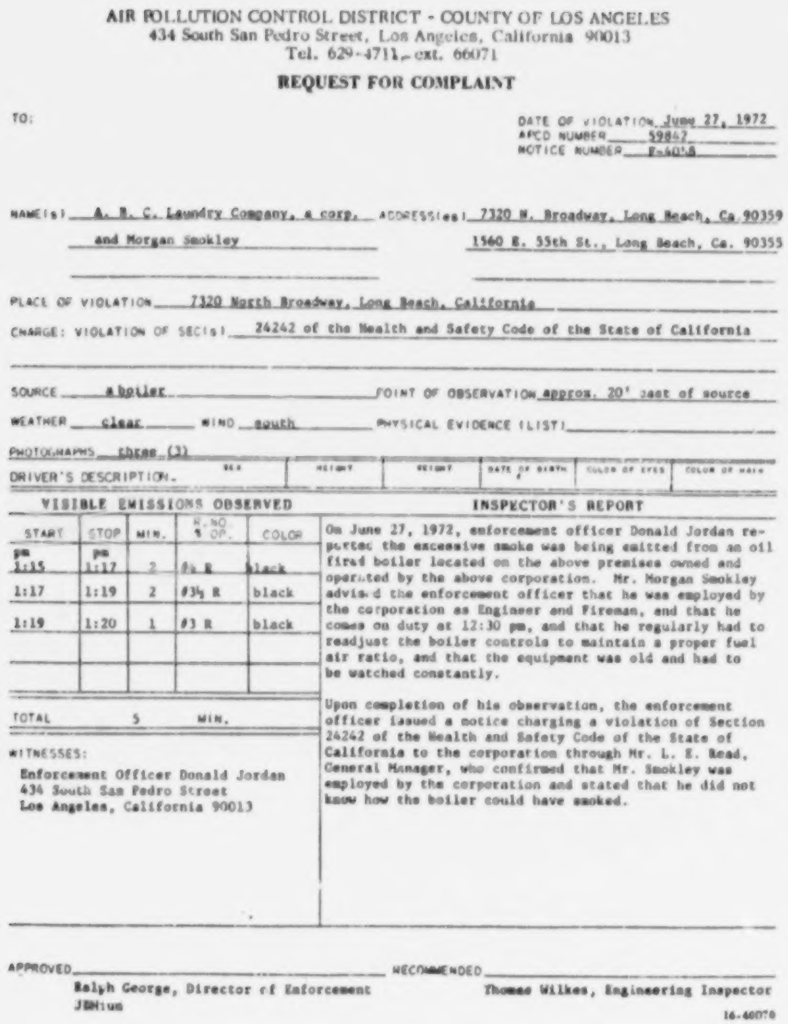
A. Case Investigation

Once the violation notice is issued, the case must be investigated to complete the facts required and to present the case in a format suitable for legal handling. This aspect of the case is usually managed by legal counsel attached to the agency; a district, city or civil attorney; a special investigation unit of the agency, or some combination of these. In some instances, although not usually, cases may be prepared and presented directly to a prosecuting attorney by a field enforcement officer.

After the notice is issued, it is reviewed for sufficiency of evidence. If the evidence is complete and valid, a Request for Complaint (Figure 3.1) is filed with the prosecuting attorney having jurisdiction and, if satisfactory, a Misdemeanor Complaint (Figure 3.2) is filed with the court. A summons or arrest warrant is then issued by the court and a date is set for the person or persons filed upon to hear and answer the charges made.

In establishing the case, the elements of the violation are abstracted from the field enforcement officer's reports. These will include, in most violations: (1) rule or state code section violated, (2) date and location of the violation, (3) the time of the violation, (4) the opacity or densities of the air contaminants, or other basic findings, (5) the identity of the air contaminants, i.e., "smoke," "dust," "mist," "fume," "gas," "vapor," (6) the names of the enforcement officers observing the violation and (7) the names and titles of the owners and operators of the equipment.(5)

The types of evidence generally required to successfully prosecute cases involving operation of equipment without a permit and other non-opacity type violations are shown below. In these cases, not all of the evidence required need be supplied by the enforcement officer. Some evidence is supplied by the investigator handling the case and, in other cases, expert opinion is obtained from specialists employed by the agency.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 South San Pedro Street, Los Angeles, California 90013
Tel. 629-4711, ext. 66071

REQUEST FOR COMPLAINT

TO:

DATE OF VIOLATION June 27, 1972
APCD NUMBER 59847
NOTICE NUMBER F-4058

NAME(S) A. B. C. Laundry Company, a corp. ADDRESS(es) 7320 N. Broadway, Long Beach, Ca 90359
and Morgan Smokley 1560 E. 55th St., Long Beach, Ca. 90355

PLACE OF VIOLATION 7320 North Broadway, Long Beach, California

CHARGE: VIOLATION OF SEC(S) 24242 of the Health and Safety Code of the State of California

SOURCE a boiler POINT OF OBSERVATION approx. 20' east of source

WEATHER clear WIND south PHYSICAL EVIDENCE (LIST)

PHOTOGRAPHS three (3)

DRIVER'S DESCRIPTION. SEX	HEIGHT	WEIGHT	DATE OF BIRTH	COLOR OF EYES	COLOR OF HAIR

VISIBLE EMISSIONS OBSERVED

START	STOP	MIN.	R.NO. % OP.	COLOR
pm 1:15	pm 1:17	2	#4 R	black
1:17	1:19	2	#3½ R	black
1:19	1:20	1	#3 R	black

TOTAL 5 MIN.

WITNESSES:

Enforcement Officer Donald Jordan
434 South San Pedro Street
Los Angeles, California 90013

INSPECTOR'S REPORT

On June 27, 1972, enforcement officer Donald Jordan reported the excessive smoke was being emitted from an oil fired boiler located on the above premises owned and operated by the above corporation. Mr. Morgan Smokley advised the enforcement officer that he was employed by the corporation as Engineer and Fireman, and that he comes on duty at 12:30 pm, and that he regularly had to readjust the boiler controls to maintain a proper fuel air ratio, and that the equipment was old and had to be watched constantly.

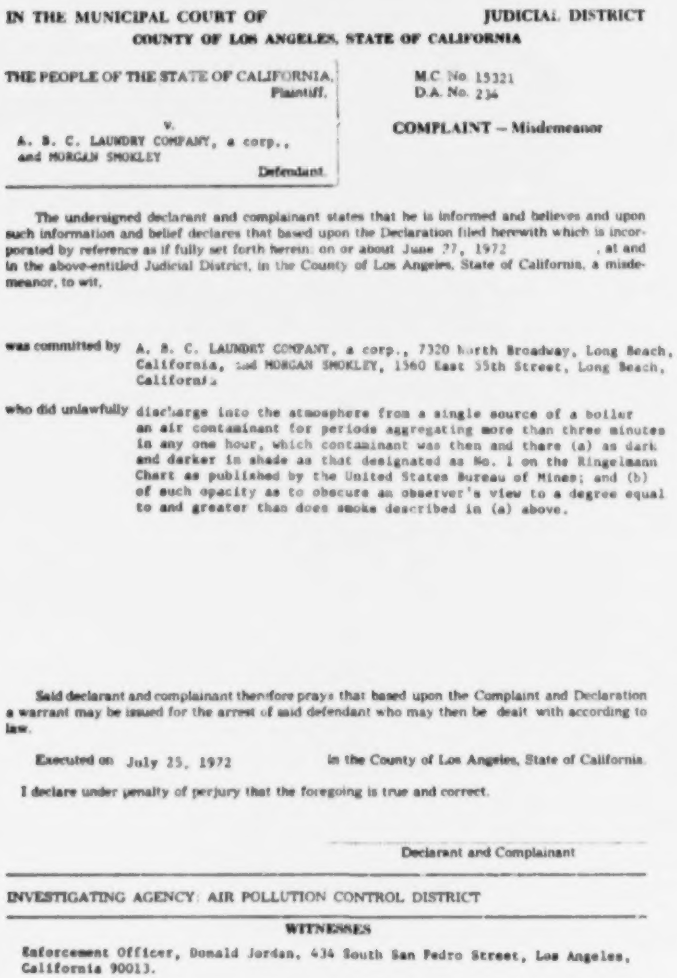
Upon completion of his observation, the enforcement officer issued a notice charging a violation of Section 24242 of the Health and Safety Code of the State of California to the corporation through Mr. L. E. Read, General Manager, who confirmed that Mr. Smokley was employed by the corporation and stated that he did not know how the boiler could have smoked.

APPROVED
Ralph George, Director of Enforcement
JBH:um

RECOMMENDED
Thomas Wilkes, Engineering Inspector

16-40070

Figure 3.1. REQUEST FOR COMPLAINT, LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT



IN THE MUNICIPAL COURT OF JUDICIAL DISTRICT
COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

THE PEOPLE OF THE STATE OF CALIFORNIA,
Plaintiff,

v.

A. B. C. LAUNDRY COMPANY, a corp.,
and MORGAN SMOKLEY
Defendant.

M.C. No. 15321
D.A. No. 234

COMPLAINT – Misdemeanor

The undersigned declarant and complainant states that he is informed and believes and upon such information and belief declares that based upon the Declaration filed herewith which is incorporated by reference as if fully set forth herein: on or about June 27, 1972 , at and in the above-entitled Judicial District, in the County of Los Angeles, State of California, a misdemeanor, to wit,

was committed by A. B. C. LAUNDRY COMPANY, a corp., 7320 North Broadway, Long Beach, California, and MORGAN SMOKLEY, 1560 East 55th Street, Long Beach, California

who did unlawfully discharge into the atmosphere from a single source of a boiler an air contaminant for periods aggregating more than three minutes in any one hour, which contaminant was then and there (a) as dark and darker in shade as that designated as No. 1 on the Ringelmann Chart as published by the United States Bureau of Mines; and (b) of such opacity as to obscure an observer's view to a degree equal to and greater than does smoke described in (a) above.

Said declarant and complainant therefore prays that based upon the Complaint and Declaration a warrant may be issued for the arrest of said defendant who may then be dealt with according to law.

Executed on July 25, 1972 in the County of Los Angeles, State of California.

I declare under penalty of perjury that the foregoing is true and correct.

Declarant and Complainant

INVESTIGATING AGENCY: AIR POLLUTION CONTROL DISTRICT

WITNESSES

Enforcement Officer, Donald Jordan, 434 South San Pedro Street, Los Angeles, California 90013.

Figure 3.2. MISDEMEANOR COMPLAINT, LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT

(1) A certified copy of the resolution of the enforcement agency regarding the adoption of the rules and regulations, and a certified copy of the rules and regulations.

(2) Stipulation or testimony given as to the ownership and location of the plant in violation.

(3) Testimony by the enforcement officer and defendant as to the construction, use and operation of the equipment in question.

  a. Date of construction, if known, or determined in the course of the inspection. Occasionally evidence may be supplied from the seller, manufacturer or installer of the equipment involved.

  b. Testimony is given regarding the operation or status of construction at the time of the enforcement officer's observation.

  c. Expert testimony as to the capability of the device to emit air contaminants.

  d. Testimony as to the enforcement officer's determination that the equipment emitted air contaminants at the time of his inspection.

(4) Testimony by an official of the agency of the non-existence of permit or authority to construct, determined from a records search.

Legal action can be taken on the basis of any enforcement officer's report provided that the evidence contained in the report is sufficient to establish the case. Action can be taken on reports which disclose:

(1) A public nuisance involving signed statements from complainants.

(2) Non-compliance warranting revocation of permits.

(3) Excessive smoke from private residences.

(4) Violations observed in connection with exemptions, breakdowns, accidents or variances. For example, the claim that a given open burning operation is "agricultural" may be disproved upon subsequent evidence. Accidental fires and equipment breakdowns may prove to have been deliberate. When terms of variances are violated, reports are rendered on inspection reports and are forwarded to the prosecutor.

Should an important element of the evidence be lacking, special investigations may be conducted. Generally such investigations establish ownership and responsibility, employer and employee relationships, etc. Equipment in question may be inspected to obtain any data needed to positively identify the air contaminants and to determine design characteristics and operational practices to establish the cause of the violation. In obtaining proof of continuity of ownership, a check may be made of corporate files, the business license bureau or the department of motor vehicles. Proof of employer-employee relationships must usually be obtained from direct testimony of the defendants, the enforcement officer's testimony or the owner's admission. Proof of the dates of construction of unauthorized equipment may be obtained from contractors, installers and sellers.

B. Preparation of Case for Court Trial

The proceeding at which the charges are read and answered is called an arraignment. Constitutional rights are extended at this time and an opportunity for plea given. The defendant can have the choice of a judge or jury trial if he pleads not guilty. A trial date is set if a not-guilty plea is made.

In general the procedure that is followed involves (1) opening arguments, (2) presentation of the people's case, (3) cross-examination of prosecution witnesses, (4) presentation of the defense case, (5) cross-examination of the defense witnesses, (6) rebuttal of both parties and (7) closing arguments.

Assuming a complaint has been filed and the case is scheduled for trial, the prosecutor and/or the agency will determine what evidence is going to be introduced and which witnesses are to be called. If subpoenas for witnesses or records are necessary they will be issued. In some cases exhibits will be prepared which are designed to clarify and summarize the evidence. For example, in a public nuisance case, maps may be prepared showing the location of the alleged source, the addresses of complainants and the wind speeds and directions at the time of complaints. Any photographs that are to be used will be carefully reviewed to be certain that they correctly represent the observations made at the time.

The past record of the defendant should be examined and the current status of the emission source determined just prior to trial.

The enforcement officers should review all the facts obtained at the time of the alleged violation and should have available all information bearing upon their qualifications. In the case of an opacity or smoke case, they should be prepared to give information on the time they last attended smoke school and their score.

C. Role of the Field Enforcement Officer as a Witness and Courtroom Procedure

The field enforcement officer in many cases will be the key and perhaps only witness for the prosecution. His testimony will have a major bearing upon the outcome of the case. It is his role to respond accurately and clearly to those questions asked of him under direct examination and cross-examination. Several of the factors bearing upon the enforcement officer's success as a witness are discussed below:

- The enforcement officer requires training in being a witness. The air pollution agency should develop training sessions based upon suggestions from the prosecuting attorney or legal counsel. It is particularly useful for a portion of this training to be in the form of a mock trial and attending actual trials.
- Each witness who must be qualified as an expert should be prepared to give a full account of his training and experience which relates to his qualifications to testify on the matters involved. He should not omit significant facts or play down his experience out of false modesty. It is helpful to keep an up-to-date biographical sketch and have the details in mind at the time of a trial.
- The enforcement officer should be thoroughly familiar with all aspects of the law as it pertains to his responsibilities. This would not only include prohibitions, but procedural matters and definitions as well.
- Do's and don't's for witnesses:
    1. Questions should be answered directly.
    2. Extended qualifications or explanations in response to questions should be avoided.
    3. The witness should think before answering a question. The attorney may use this opportunity to raise valid objections.
    4. The witness should be honest and not stretch facts.
    5. The witness should not interpret facts unless called upon to do so as an expert witness.
    6. The witness may refresh his memory from notes even though he may not read directly from them.

7. The witness should make judicious use of technical terms and use straightforward language wherever possible. Descriptive terms should be used that will convey a picture.
8. The witness should not "talk down" to the judge or jury.

The proceedings in a judicial hearing or court follow strict rules which the officers of the court are bound to follow. The prosecuting attorney and/or the legal counsel of the agency are such officers and are responsible for the conduct of the case.

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CHAPTER 4
INSPECTION TECHNIQUES

I. INTRODUCTION

The success of any field enforcement program ultimately depends on the specific techniques employed by field enforcement personnel to inspect the sources of air pollution. Inspection techniques consist of the methods employed to observe processes and equipment, collect and evaluate data and evidence, interview owners, operators and citizens, use field testing equipment and prepare reports.

The importance of technique cannot be overly emphasized. Air pollution control agencies with adequate enforcement powers, but defective inspection and enforcement procedures may lose some of these powers as a result of adverse court decisions. Control agencies beginning operations with inadequate enforcement powers may gain needed powers through proof of the need for new rules based on data and evidence compiled through the use of expert inspection techniques.

II. IDENTIFICATION OF EFFLUENT PLUMES

The ability to identify, describe and evaluate air pollution emissions and the factors contributing to their formation is a fundamental inspection technique. Three important levels of understanding, or points of view, must be considered:

1. The Microscopic. The properties and behavior of the smallest units of air pollution measured by instruments and techniques of scientific analysis. This point of view is generally assumed by the chemist and physicist.

2. The Megascopic. Aggregated source activities, mass emission rates and large-scale behavior of polluted air masses. This point of view is assumed by the meteorologist.

3. The Macroscopic. Observations and evaluations of the behavior of individual source emissions, effluents and air pollution effects made by means of the sense perceptions and by inductive and deductive techniques. This point of view may be based on assumptions concerning microscopic and megascopic phenomena and available source and environmental measurement data. This point of view is assumed by the field enforcement officer and the air pollution control engineer.

By applying understanding of the principles and processes of air pollution, any emission source problem may be broken down into the following elements.

1. The possible, probable or direct cause of the air pollution emission in terms of equipment, operation, design, maintenance, fuels, or material fed.
2. The air pollution plume or effluent as emitted, and rate or quantity.
3. The possible contaminants in the emission.
4. The effects of the contaminants in the atmosphere – clouds, hazes, reduction of visibility, photochemical effects, etc.
5. The effects of contaminants on life and property such as odor, corrosion, toxicity, deposits and eye-irritation.

The field enforcement officer must demonstrate that observations and data required on the macroscopic level prove the presence of an air contaminant, that is, an effluent that is not water vapor or a natural constituent of the atmosphere, and that the emission violates a standard. He must also establish the factors which caused the emission to violate the standard. To accomplish this, he should be prepared to describe the events occurring in each stage or element of the air pollution problem.

A. Air Pollution Configurations

Any substance emitted from any process into the atmosphere may be termed an "effluent." On emerging from a stack, the effluent flows in rather concentrated form through a moving and often ill-defined region of the atmosphere called a plume, which is frequently made manifest by the presence of visible components in the effluent that move through it. Visible effluents are those which consist of any one or combination of the following contaminants:

(1) A sufficient concentration of a colored contaminant gas, such as nitrogen dioxide (brown to yellow), bromine (reddish-brown), iodine (purplish) and chlorine (greenish-yellow). With the exception of these gases, however, virtually all contaminant gases significant in air pollution are colorless.

(2) Aerosols, i.e., entrained particulate matter.

In the case of aerosols, the visual threshold depends on the intensity and the direction of the light source with respect to the observer, and the position and concentration of the effluent. The maximum visibility reduction occurs when the light source is directly opposite the observer and behind the effluent. As the observer changes his angle of position, the visual effect of the light scattering diminishes until, at a change of 180° of position, the visual effect is at a minimum.

Effluents are invisible when the aerosols cannot be seen with the naked eye, or they consist of colorless gases, or the concentrations of visible materials are too low to be observed.

Three basic configurations of contaminants may be observed by the field enforcement officer.

1. The Plume

The plume is the contaminant-laden gas stream from a specific outlet such as a stack or vent. The plume, particularly when it is distinctly visible, is characterized by (1) a point of release and formation just at the outlet of a stack or opening of a closed system, or a few feet above the outlet in the case of a "detached" plume, (2) the body or stream, carrying relatively concentrated contaminants, confined by the momentum of the escaping gases and sometimes (3) a point at which the plume appears to dissipate (see Figure 4.1).

The point of discharge of the emission, or the point of maximum opacity, is the point at which the opacities of visible emissions are read. The stream of pollution provides some relative notion of quantity and velocity of the escaping contaminants, as well as other characteristics such as color and particle size which help identify the plume. The point of dissipation is important in determining whether or not the plume is a contaminant, water vapor or steam, or some combination of both. Depending on wind velocity, humidity and temperature, condensed water vapor or steam may dissipate more rapidly than contaminants contained in the plume. The greater the humidity, generally speaking, the longer the steam plume. Where most of the effluent appears to consist of water vapor, the opacities or densities of the contaminants are read at the point of dissipation or evaporation of the steam.

General atmospheric conditions may also be indicated by the behavior of the plume, and may be of significance in assessing a nuisance potential. A plume which rises rapidly indicates rapid vertical mixing of contaminants favorable to the dispersion of the contaminants. Horizontal plumes may cause fumigation of an area down-wind from the source of emission. The direction and extent of diffusion may then be indicated by the type of plume. A plume which disperses both vertically and laterally is known as a coning plume, in that the shape of dispersion is in the

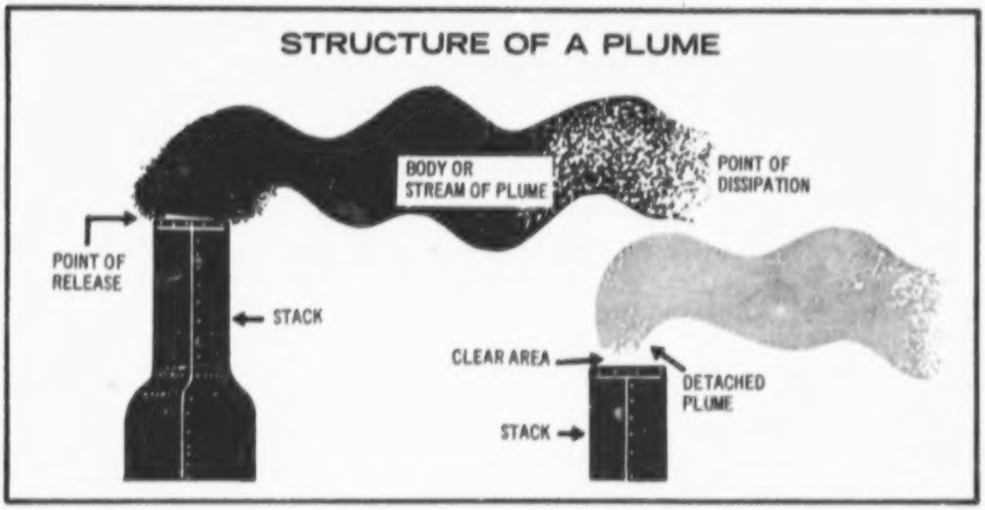

STRUCTURE OF A PLUME
BODY OR STREAM OF PLUME
POINT OF DISSIPATION
POINT OF RELEASE
STACK
CLEAR AREA
DETACHED PLUME
STACK

Figure 4.1. GENERAL STRUCTURE OF CONTINUOUS AND DETACHED PLUMES

(SOURCE: WEISBURD, Reference 3)

form of a cone. A coning plume generally results when wind speeds are in excess of 20 miles per hour. A looping plume occurs in turbulent or gusty atmospheres and, in general, results in good dispersion and only sporadic fumigation. A fanning plume generally results from a steady and sometimes slow wind stream, and tends to maximize the area of effective fumigation possible at relatively high contaminant concentrations.

In most cases, a trained observer can distinguish smokes and mists by color, behavior and dissipation point. He can distinguish between emissions of smoke resulting from rubbish burning, fuel-oil burning and even natural gas, when gas-fired boilers are severely out of adjustment, by color and escape velocity of the body of the plume.

Invisible plumes, i.e., escaping gas streams, can frequently be inferentially detected by sound of gases escaping from high pressure systems and light refraction (shadows cast by evaporating vapors) from low pressure systems. Some gases, like butane or propane under high pressure, can be detected by frosting at the point where the pressure drop occurs at the valve and still others by the physiological responses of those near the source. Some gases may be detected by odor or by irritation of the mucosa or eyes.

2. The Cloud

A cloud of air pollution is an emission of air contaminants which has become completely divorced from its source, or sources, and is gradually being dissipated by the processes of dilution, sedimentation and diffusion, but may still retain visible boundaries. The cloud is shaped by the direction of air flow, and by dilution which occurs at right angles to this flow. The cloud is the extension, or the fanning effect, of the plume and generally occurs under conditions of relative atmospheric stability. Clouds are often produced from large source emissions and from building, brush and forest fires. Generally speaking, the larger the quantity of air pollutants, the longer a cloud remains coherent.

Noting the appearance of clouds in reports, especially as to height, length, breadth and thickness, can be important in determining the severity of a general or local problem. Pollution clouds may be invisible. These may sometimes be detected by smell, if the contaminants are odorous gases, and their extent can be investigated by a field enforcement officer (or a team of officers) as described in Chapter 6, Section V, Odors.

3. The Haze

Hazes are frequently formed by condensation of vapors on atmospheric particles, or by aerosol production in smog formation, and by dusts and pollen. Smog is itself a chemical haze. A haze may also be considered as a more attenuated form of cloud residing at ground level, representing a condition of atmospheric stagnancy. Notation of the existence of the haze is important, particularly when it is peculiar to a community, since an acute local problem may be present.

B. Types of Effluent Plumes

The plume represents the form of the air contaminant of primary interest. It is the "discharge" or "emission" regulated or prohibited in most statutes or rules.

Since all substances become liquid, solids and gases at certain temperatures, the plume may consist of a variety of contaminants in various states of matter. Smoke, for instance, contains visible aerosols--carbon particles and solid or liquid particles of partially burned fuels--and such gases as sulfur dioxide, oxides of nitrogen, and unburned vapors.

The identity ascribed to the plume is usually made in terms of its outstanding visual characteristic. For example, even though sulfur dioxide may be the most significant of the pollutants emitted from a given stack, the effluent in which it is contained is frequently described as smoke due to the visible soot, carbon particles and fly ash contained in the plume.

The mere observation of a plume, however, does not result in its conclusive identification. Knowledge of the specific conditions which caused the contaminants is required. The distinction between smoke and fumes cannot be made unless the processes by which they are generated are described.

1. Smoke

Smoke is the visible effluent resulting from incomplete combustion. It consists mostly of soot, fly ash and other solid or liquid particles less than one micro-meter in diameter. Depending upon the composition of the fuel or materials being burned and the efficiency of combustion, various volatilized gases and organics such as aldehydes, various acids, sulfur oxides, nitrogen oxides and ammonia may also be emitted. Due to the low vapor pressures and slow settling properties of the particles, the smoke may be carried considerable distances from the source and many submicro-meter particles will be permanently dispersed in the atmosphere.

Smoke will vary in color, but will be generally observed as grey, blue, black, brown and white, and sometimes yellow, depending upon the conditions under which certain types of fuels or materials are burned. The color of smoke is generally a fairly good indication of the type of combustion problem encountered.

Smoke which is grey or black in color may indicate that material is being burned with insufficient air or inadequate mixing of fuel and air.

White smoke usually results when combustion is cooled by excessive drafts of air, or when the materials being burned contain excessive amounts of moisture.

Brown or yellow smoke may result from the burning of semi-solid tarry substances such as asphalt or tar paper, resulting from inadequate temperature and mixing.

A blue color or light blue color is often associated with the burning of domestic trash consisting mostly of paper or wood products. The light blue color seems to stem from the fine particles of pyroligneous acid due to sulfide treated paper and wood tar constituents. The blue plume contains little or no carbon or soot particles.

2. Fumes

In air pollution control, fumes are referred to specifically as "condensed fumes." These are minute solid particles generated by the condensation of vapors from solid matter after volatilization from the molten state, or may be generated by sublimation, distillation, calcination or chemical reaction when these processes create air-borne particles. Fume particles are generally less than one micro-meter in diameter and will behave like smoke. Fumes will more commonly consist of metals and metallic oxides and chlorides. Also contained in the fumes are common solid particulates such as fly ash, carbon, mechanically-produced dust and gases such as sulfur dioxide. The fumes principally emitted, however, are actually dusts condensed from the more volatile elements in the metals melted such as zinc, sulfur, lead and others.

The enforcement officer will probably be mostly concerned with metallurgical fumes. The metallurgical fume will consist primarily of the metallic oxide which is driven from the melting surface when metal is heated to the molten state. Metals such as copper and bronze with relatively high boiling temperatures, as compared to their melting and pouring temperatures, do not readily volatilize and do not constitute an air pollution problem. Copper and tin, for example, have boiling temperatures above 4000°F., but are poured at temperatures at about 2000°F.

Some metals may contain alloys with extreme differences in volatility. Copper-based alloys such as yellow brass, manganese bronze, brazing spelter and various plumbing metals contain from 15 to 40 per cent zinc, the boiling temperature of which is around 2200°F. Since the metal must be heated to melt the copper which has the highest pouring temperature, a portion of the zinc will be brought to its boiling point and will volatilize. Copper alloys with high zinc contents may lose from 2 to 15 per cent of their zinc through fuming.

When vented to the atmosphere, fumes may have the appearance of smoke. However, all of the sources of fumes may not be practically vented in a large-scale foundry operation, so that fumes in the vicinity of a plant may appear as a haze or a cloud emitted from factory monitors and windows.

Other processes which will produce fumes include calcination, sublimation and distillation.

Calcination consists of heating, roasting or smelting to decompose minerals. Calcination is commercially applied in the manufacture of glass and mineral catalysts through the heating of materials such as sand and limestone. It is variously employed to remove moisture or a volatile constituent by such methods as heating limestone to form carbon dioxide gas and calcium oxide, or to reduce minerals by oxidation.

Sublimation is the process in which a solid substance is converted to a gas without a change in composition and without first going through the liquid state. Iodine, carbon dioxide (dry ice) and many metallic and nonmetallic crystals are examples of sublimed materials. Sublimation of these materials may be accomplished by lowering the pressure, raising the temperature or by changing both temperature and pressure.

Distillation is a cycle of vaporization and condensation in which a liquid is converted to a vapor and condensed to a liquid. Distillation is generally employed to purify a liquid or to segregate components according to relative volatility.

3. Dusts

Dusts are minute solid particles released in the air by natural forces or by mechanical processes such as crushing, grinding, melting, drilling, demolishing, shoveling, sweeping, sanding, etc. Dust particles are larger and less concentrated than those in collodial systems, such as smoke and fumes, and will settle fairly quickly on surfaces. A dust effluent, however, may also contain many submicroscopic particles.

Dusts are produced from virtually every human activity as well as from the natural environment. Some dusty industries include mineral earth processors sucn as ceramic and cement manufacturing, calcining, and wood-working and feed and flour industries.

Dust particles mainly exceed one micro-meter in diameter and are readily controlled by centrifugal separators, cloth filters and electrostatic precipitators.

4. Mists

Mists consist of liquid particulates or droplets, less than the size of raindrops, such as fog, and are formed by condensation of a vapor or atomization of a liquid by mechanical spraying. Mist droplets may contain contaminant material in solution or suspension. The impregnation and coating of building materials with asphalt or the manufacture or heating of asphalt at batch plants may produce hazes or fogs containing droplets of liquid asphalt. Paint spraying operations emit liquid particulates containing organic solvents, pigments and other materials. Mists may also be emitted from control devices such as cyclones and scrubbers, using a liquid air cleaning medium. Acid particulates, such as chromic and sulfuric acid produced from chrome plating operations, may also form mists when exhausted to the atmosphere.

In large oil-burning installations, sulfur trioxide is formed as a gas, and, after contact with sufficient moisture in the air, forms as a white-to-blue plume several feet above the stack (detached plume). After further contact with moisture in the air, the sulfur trioxide is transformed to a sulfuric acid mist.

5. Gases

A gas is a non-coherent state of aggregated matter, i.e., a fluid of freely-moving molecules tending to expand infinitely and to diffuse and mix readily with other gases. As pollutants, gases include a large variety of inorganic and organic gases which may have noxious, malodorous, toxic or corrosive effects, or which may have an effective smog-producing potential. These include carbon monoxide (CO), ozone (O_3), oxides of nitrogen (NO, NO_2), sulfur dioxide (SO_2), hydrogen sulfide (H_2S), hydrocarbons and their oxidation products, halogens (chlorine, bromine, fluorine, iodine) and their derivatives such as hydrogen fluoride (HF), and various chlorinated solvents such as those used in industrial degreasing and dry cleaning. Other important toxicants include ammonia (NH_3), arsine (AsH_3), fluorine (F_2), hydrogen chloride (HCl), phosgene ($COCl_2$) and hydrogen cyanide (HCN).

Two gases which commonly occur in air pollution problems as a result of direct emission to the atmosphere are described below.

a. Sulfur Dioxide

Sulfur dioxide is a common stack gas produced from the combustion of sulfur-containing fuels such as coal and fuel oil, the burning off of residue on catalyst in oil refining operations, the burning of tail gases from the recovery of sulfur from refinery waste gases, and various other chemical and metallurgical processes. A major source of sulfur dioxide is the burning of coal and fuel oil by refineries and power plants. Crude oil with sulfur content contains from less than 1 percent sulfur to 5 percent in some of the heavier fuels. SO_2 has a noticeable odor at comparatively low concentration and will damage certain species of vegetation at 1/4 ppm. Sulfur dioxide gases and sulfuric acid mists are capable of accelerating the corrosion of wires, metals and other materials.

b. Hydrogen Sulfide, Organic Sulfides and Mercaptans

Both thermal and catalytic cracking processes in oil refining operations convert the sulfur contained in the crude oil into hydrogen sulfide in the heavier materials and mercaptans in the gasoline fractions. The same substances are also produced in Kraft paper mill processes. When hydrogen sulfide is released to the atmosphere as a gas, it manifests a characteristic rotten egg odor. Mercaptans also exhibit varying types of strong unpleasant odors such as garlic, decayed garbage, skunk or onions from relatively small gas concentrations. Hydrogen sulfide is detectable at .12 ppm and mercaptans from .001 to .041 ppm. H_2S will also discolor some painted surfaces with lead pigments under humid conditions.

6. Vapors

A vapor is the gaseous phase of a substance which at normal temperature and pressure is a liquid or solid.

The most important vapor air pollution problem is that which results from the evaporation of petroleum products, such as the unburned gasoline vapors in automobile exhaust. Gasoline vapors also originate from processes in which volatile products are maintained in storage tanks and from the operation of pumps, compressors and blowers required for moving liquid gas streams.

Another principal source of vapors originates from the consumption, marketing and manufacture of paints and other coating products containing organic solvents which are used to dilute or extend surface coatings. These are released to the atmosphere upon application.

III. PLUME EVALUATION

Once a plume or effluent is identified as an air contaminant, it must be measured by some standard to determine whether or not a violation of the law has occurred, or it must be evaluated to determine the size or severity of a given air pollution problem.

Compliance with maximum permissible emission standards is determined by visual evaluation of visible emissions, and source testing of emissions which are invisible or near the threshold of vision. This section is concerned with the evaluation of visual emissions by the use of the Ringelmann standard and equivalent procedures.

Visual observation of plumes by field personnel can be an effective and economical method of determining compliance with air pollution regulations, provided the regulations are based on the visual aspect of plumes or on other properties that can be shown to be directly related to the visual aspect.

The benefits of basing smoke statutes on opacity or density are quite evident, even though equipment and fuel regulations have increasingly assumed precedence in control legislation. When the visual standard is specific with reference to a cut-off point and time interval, it is simply and directly enforced. All enforcement officers need do is observe an emission of an opacity or density beyond that allowed for a specific period of time in order to cite a violator for excessive smoke. Although the visual standard is limited to estimations of particulate pollution which obscures vision, its application simultaneously tends to reduce grain loading and gaseous contaminants. (As the grain loading in the plume increases, the light transmission decreases exponentially.) In order to comply with the opacity standard, more efficient combustion or equipment operation is necessary. The Ringelmann standard, therefore, is most versatile in accomplishing gross reductions of atmospheric pollutants in a community, and can be applied not only to smoke, but to fumes, dusts and mists arising from a variety of problems.

It should be cautioned, however, that while such benefits can be assumed, they cannot always be precisely predicted or evaluated. Determination of opacity and shade of any emission alone gives no specific measurement of the quantities of contaminants being emitted.

A. Description and Use of the Ringelmann Chart

The history, description and general use of the Ringelmann Chart is discussed in the Bureau of Mines Information Circular #7718 (August, 1955).(1) Since this document has formed the basis of smoke regulations in many cities and is used as evidence in many court actions, it is quoted extensively here.

> ### Introduction
>
> The Ringelmann Smoke Chart (Figure 4.2), giving shades of gray by which the density of columns of smoke rising from stacks may be compared, was developed by Professor Ringelmann of Paris. Maximilian Ringelmann, born in 1861, was professor of agricultural engineering at l'Institute National Agronomique and Director de la Station d'Essais de Machines in Paris in 1888, and held those positions for many years thereafter.

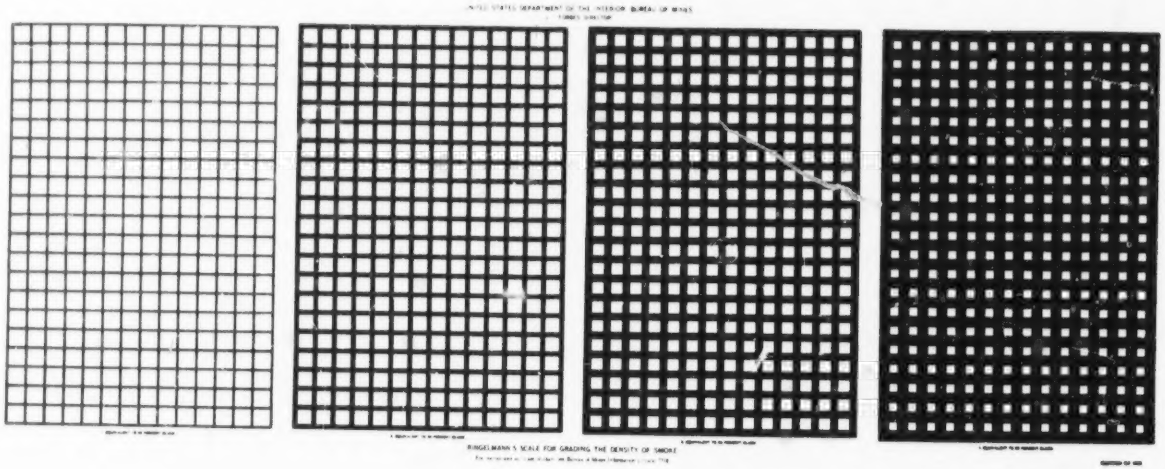

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF MINES
RINGELMANN'S SCALE FOR GRADING THE DENSITY OF SMOKE

Figure 4.2. RINGELMANN'S SCALE FOR GRADING THE DENSITY OF SMOKE

(SOURCE: DUKLICH, Reference 1)

The Ringelmann Chart was used by the engineers of the Technologic Branch of the Federal Geological Survey (which later formed the nucleus of the present Bureau of Mines) in their studies of smokeless combustion beginning at St. Louis in 1904. By 1910, it had been recognized officially in the smoke ordinance for Boston passed by the Massachusetts Legislature.

The chart is now used as a device for determining whether emissions of smoke are within limits or standards of permissibility (statutes and ordinances) established and expressed with reference to the chart. It is widely used by law-enforcement or compliance officers in jurisdictions that have adopted standards based upon the chart.

Description and Method of Preparing the Chart

The Ringelmann system is virtually a scheme whereby graduated shades of gray, varying by five equal steps between white and black, may be accurately reproduced by by means of a rectangular grill of black lines of definite width and spacing on a white background. The rule given by Professor Ringelmann by which the charts may be reproduced is as follows:

Card 0—All white.
Card 1—Black lines 1 mm. thick, 10 mm. apart, leaving white spaces 9 mm. square.
Card 2—Lines 2.3 mm. thick, spaces 7.7 mm. square.
Card 3—Lines 3.7 mm. thick, spaces 6.3 mm. square.
Card 4—Lines 5.5 mm. thick, spaces 4.5 mm. square.
Card 5—All black.

The chart, as distributed by the Bureau of Mines, provides the shades of Cards 1, 2, 3, and 4 on a single sheet, which are known as Ringelmann No. 1, 2, 3, and 4, respectively.

Use of Chart

For the process of instruction, the chart is supported on a level with the eye, at such a distance from the observer that the lines on the chart merge into shades of gray, and as nearly as possible in line with the stack. The observer glances from the smoke, as it issues from the stack, to the chart and notes the number of the chart most nearly corresponding with the shade of the smoke, then records this number with the time of observation. A clear stack is recorded as No. 0, and 100 per cent black smoke as No. 5.

To determine average smoke emission over a relatively long period of time, such as an hour, observations are usually repeated at one-fourth or one-half minute intervals. The readings are then reduced to the total equivalent of No. 1 smoke as a standard. No. 1 smoke being considered as 20 percent dense, the percentage "density" of the smoke for the entire period of observation is obtained by the formula:

$$\frac{\text{Equivalent units of No. 1 smoke X 0.20}}{\text{Number of observations}} = \text{percentage smoke density}$$

The timing and extent of observations made for the purpose of determining compliance with a local smoke abatement ordinance depend upon the wording and smoke limitations of the ordinance.

There are two general methods of using the chart. One is for the observer to make actual reference to it, as previously described, while judging the smoke shade. The other method is based on the fact that, with proper experience, it is unnecessary for an observer to continue to refer to the chart. By repeated reference to the chart, during a suitable training period, the shades of the Ringelmann scale become fixed in the observer's memory. Hence, the chart is used by most cities only for training and examination of smoke inspectors, before certification that they are proficient in judging smoke shade on the Ringelmann scale without referring to the chart. Since smoke-shade observations by inspectors, thus trained and certified, are easily made and are accepted as evidence in courts, this latter method of using the chart is preferred by most authorities.

B. Smoke Measuring Methods

Although most control agencies have employed the Ringelmann Chart as a means of defining smoke standards, other methods are available for use in the field. Some agencies use special measuring devices, whereas other agencies train their personnel to sight-read the effluent emissions within a prescribed degree of accuracy without making direct reference to the Ringelmann Chart. Some of the devices used are described as follows:

(1) Smoke Tintometer

This instrument, developed prior to 1912, used tinted glasses graduated to the Ringelmann scale for visual comparison with the smoke. It contains two apertures, one for observing the smoke and one for viewing the clear sky through the opening or through one of the tinted glasses. This instrument is probably not significantly more effective than a trained sight-reader.

(2) Umbrascope

This is a tube using tinted glass segments which can be adjusted to cover one-half of the field of view. The smoke can then be compared visually with the darkness of the glass. Its main disadvantage is its small range.

(3) Smokescope

This instrument uses a film disc of two shades graduated to #2 and #3 on the Ringelmann Scale. One aperture is used for viewing the smoke and one for viewing the film reference disc against the background. Its disadvantage is that the quantity of light falling on the reference disc may be influenced by objects nearly in line with the smoke. Judgment and skill are required in its use.

(4) Photoelectric Cells

Photoelectric smoke metering equipment measures variations in the intensity of a beam of light passing through the effluent in the stack, thus directly measuring opacity or optical density. Because the equipment is permanently built into the stacks at the sources of air pollution, these devices are not portable for transporting by field inspectors to the stacks. However, they may be required either by permit condition or law to be constructed, and are of particular importance in training air pollution inspectors to sight-read effluents.

(5) Smoke Comparison Charts

Several smoke comparison charts were reported in the A.S.M.E. (1963) Power Code. One of these was a circular chart with radial lines of various widths. The operator spins the chart on an object inverted through a hole in the center of the chart. The apparent shades of gray on the spinning chart are then compared with the smoke. Shades of gray have also been produced on photographic film for smoke comparison charts. Another device consists of black lines photographed on celluloid film which is seen partly by transmitted light and partly by reflected light.

(6) Smoke Inspection Guide

A film strip presenting optical densities of 80, 60, 40 and 20 percent transmission has been developed by the Public Health Service. Film strips meeting the design and test specifications announced by the Public Health Service may be identified by a statement to that effect, citing "smoke inspection guides developed by the U.S. Public Health Service (42 CFR Part 75)."(2)

C. Principles of Smoke and Opacity Reading

The Bureau of Mines pamphlet, quoted previously, describes the various cards of the chart. The terms "density" and "opacity," however, as used in the literature are only inferentially defined. The semantics of these have been the subject of much controversy and have been confused by defense attorneys attempting to invalidate the smoke reading procedure.

The definitions(3) of these terms are, however, rather simple, as they are limited by the law and the nature of the Ringelmann Chart.

(1) Smoke Density

"Density" means the "quantity of anything per unit of volume or area," as defined by Webster's Dictionary. An examination of the Ringelmann Chart discloses the obvious fact that the shades of gray smoke are reproduced according to the ratio of the area occupied by the black grid lines to the total area of each card, and are expressed as the percent of each card blackened. Since the black grid lines represent opaque areas, and the white spaces the area through which light is transmitted, it is implicit in the design of the Ringelmann Chart that "smoke density" can only be defined as a measure of degree of opacity. This definition does not imply any relationship with the definition which might be made in terms of "weight per unit volume."

(2) Opacity

The term "opacity" means the degree to which transmitted light is obscured. The degree of opacity is usually rated directly in percentage of perfect opacity, 0 percent opacity being equivalent to perfect transparency, and 100 percent opacity being perfectly opaque. In air pollution work opacity is actually judged by the degree to which an observer's view is obscured. This manner of observing and recording the opacities of visible emissions should be implicit in the law. For instance, typical regulations prohibit smoke of periods totaling more than three minutes in any one hour . . .

- . . . as dark or darker in shade as that designated as No. 1 on the Ringelmann Chart . . .

- Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke...(described above)

It is obvious that the Ringelmann Chart and the Opacity method are measured in direct equivalents. The determination of density is actually the determination of opacity. The difference is that the Ringelmann Chart is a recognized standard applied only to shades of gray smoke. The opacity system is applied only to the shades of white or colored emissions.

(3) Other Principles

In reading smoke it is not necessary for a trained observer to actually use the Ringelmann Chart in his smoke measurement. The thought process is the same without the chart for all color emissions. The U.S. Bureau of Mines pamphlet states that "observers with proper experience find it unnecessary to continue to refer to the chart." The Superior Court of Los Angeles County ruled that "in proving a violation, a witness may testify although he did not have a Ringelmann Chart actually in the field with him at the time he made his observations. One does not have to have a color chart in his hands to recognize a red flower, a blue sky, or a black bird."(4) Thus, through training and repeated examination, enforcement personnel are made proficient in applying standard Ringelmann reference readings to field determination of both the shade and density or opacity of any visible emission, without regard to its basic color—whether black, white, yellow or any other color.

The A.S.M.E. Power Test Code(5) states that smoke may be read with Ringelmann Charts from several blocks away with a clear atmosphere and clear sky. Thus the distance from the smoke is limited primarily by conditions of visibility and positive identification of the source. The 1955 revision of the Bureau of Mines circular does not specify any required distance from the smoke.

The A.S.M.E. recommends placing the chart so that the same light falls on the chart as on the smoke. The observer should not be looking toward the sun while the face of the chart is shaded. About the same amount of light should be reflected from the white portion of the chart as comes from the background of the smoke. Opaque smoke charts are seen wholly by reflected light while light colored smoke is seen mainly by transmitted light. Thus, with a properly placed chart, 60 percent of the light reflected from a No. 2 Ringelmann Chart is equal to 60 percent of the light transmitted through a No. 2 black smoke plume.

(4) Steam Condensation in Plumes

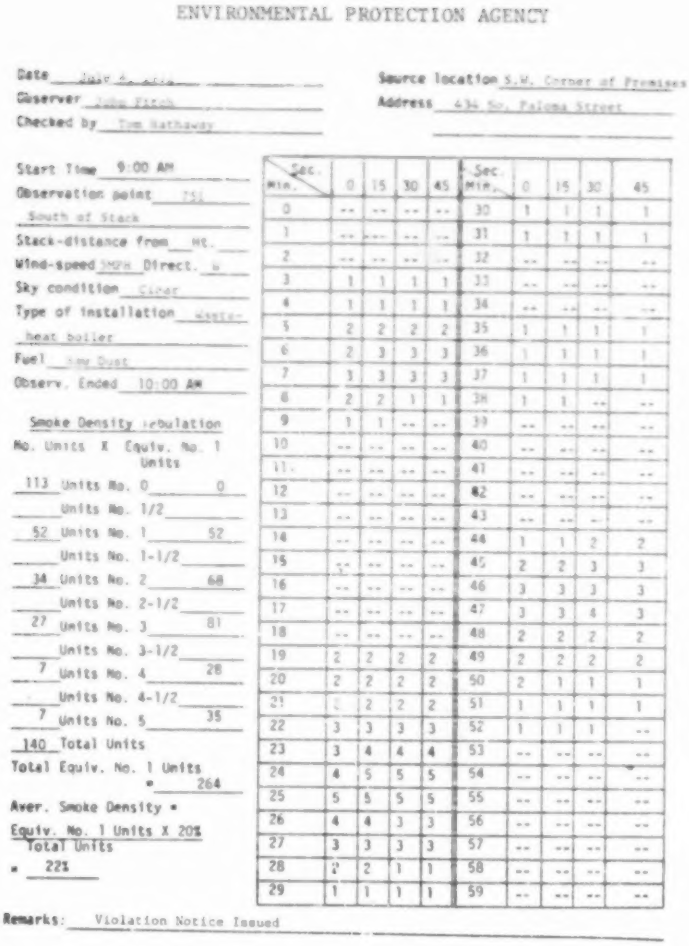
In a plume containing sizable quantities of water vapor, condensation will frequently start either in the stack or very shortly above it, and will greatly increase the opacity of the plume. The ordinance to be enforced may specify that opacity exceeding the designated limit is prohibited only if it is caused by a contaminant. Under some conditions it may not be possible to determine this question visually, unless water vapor is considered a contaminant. However, if opacity exceeds the limit in any part of the plume in which condensed steam is not present, the source is clearly in violation of the ordinance.

D. Costs and Benefits of Plume Evaluation Training(6)

The use of the Ringelmann Chart and equivalent opacity principle is within the means available to state and municipal health and air pollution agencies, since the cost is normally only that of training existing personnel. After the initial intensive training of 24-32 hours, only about 24 hours per year are necessary to test and refresh personnel in the techniques of evaluating plumes. An efficient portable smoke generator can be built or purchased commercially for about $3,000 and the operation of it is very inexpensive, about $1.50 per hour. Besides this, many smoke reading courses are now being offered throughout the country by various municipal, state and federal agencies. Most of these courses are open to enforcement personnel at a very nominal charge or no charge whatsoever.

Once trained and qualified, one field enforcement officer can make many observations in one day. A particulate source test takes a minimum of one day for testing plus the time needed for laboratory analysis and report writing at a minimum cost of $1,000 per source. While it is not feasible, because of cost and time, to test every available source, it is feasible to evaluate each source many times by visible observation. A field enforcement officer can normally choose a vantage point where more than one source can be viewed at one time. Also these sources can be evaluated under varying operating conditions, while a source test is only valid at the conditions in force at the time of sampling.

Since it has been shown that with proper training under varying conditions, that a field enforcement officer can evaluate plumes within an average deviation of not more than 10 percent and most can even come closer to 5 percent, the courts have upheld the Ringelmann and Opacity principles when used by qualified personnel and with good judgment. It is necessary to have accurate records of the field enforcement officer's readings on the smoke generator to offer as evidence of his qualifications. Also, it is necessary to have an accurate and complete record of his readings at the source of complaint, as well as support data on sky conditions, wind speed and direction, and general meteorological conditions (see Figure 4.3) during the time the source was observed. Plume evaluation training confers on the field enforcement officer the necessary expertise to realize these benefits.



ENVIRONMENTAL PROTECTION AGENCY

Date July 4, [illegible]
Observer John Fitch
Checked by Tom Hathaway

Source location S.W. Corner of Premises
Address 434 So. Paloma Street

Start Time 9:00 AM
Observation point 75'
South of Stack
Stack-distance from Ht.
Wind-speed 5MPH Direct. W
Sky condition Clear
Type of installation Waste-heat boiler
Fuel Saw Dust
Observ. Ended 10:00 AM

Smoke Density Tabulation

No. Units X Equiv. No. 1 Units
113 Units No. 0 0
Units No. 1/2
52 Units No. 1 52
Units No. 1-1/2
34 Units No. 2 68
Units No. 2-1/2
27 Units No. 3 81
Units No. 3-1/2
7 Units No. 4 28
Units No. 4-1/2
7 Units No. 5 35
140 Total Units
Total Equiv. No. 1 Units = 264

Aver. Smoke Density = Equiv. No. 1 Units X 20% / Total Units
= 22%

Sec. / Min.	0	15	30	45	Sec. / Min.	0	15	30	45
0	--	--	--	--	30	1	1	1	1
1	--	--	--	--	31	1	1	1	1
2	--	--	--	--	32	--	--	--	--
3	1	1	1	1	33	--	--	--	--
4	1	1	1	1	34	--	--	--	--
5	2	2	2	2	35	1	1	1	1
6	2	3	3	3	36	1	1	1	1
7	3	3	3	3	37	1	1	1	1
8	2	2	1	1	38	1	1	--	--
9	1	1	--	--	39	--	--	--	--
10	--	--	--	--	40	--	--	--	--
11	--	--	--	--	41	--	--	--	--
12	--	--	--	--	42	--	--	--	--
13	--	--	--	--	43	--	--	--	--
14	--	--	--	--	44	1	1	2	2
15	--	--	--	--	45	2	2	3	3
16	--	--	--	--	46	3	3	3	3
17	--	--	--	--	47	3	3	4	3
18	--	--	--	--	48	2	2	2	2
19	2	2	2	2	49	2	2	2	2
20	2	2	2	2	50	2	1	1	1
21	2	2	2	2	51	1	1	1	1
22	3	3	3	3	52	1	1	1	--
23	3	4	4	4	53	--	--	--	--
24	4	5	5	5	54	--	--	--	--
25	5	5	5	5	55	--	--	--	--
26	4	4	3	3	56	--	--	--	--
27	3	3	3	3	57	--	--	--	--
28	2	2	1	1	58	--	--	--	--
29	1	1	1	1	59	--	--	--	--

Remarks: Violation Notice Issued

Figure 4.3. PLUME OBSERVATION RECORD FORM

(SOURCE: ROM, Reference 6)

E. Smoke Reading School

With these principles clearly and legally established, it is now possible to train personnel to become expert smoke readers. An expert smoke reader can be defined as one who can distinguish smoke densities within a margin of error of 1/2 Ringelmann or 10 percent opacity in a significant number of readings during both the hours of light and darkness and from any given view of the emission.

1. Smoke Generating Equipment

In the design of smoke generating equipment, attention is given to a means of regulating air fuel ratios, to preventing horizontal distortion of the smoke plume through the action of wind and to make accurate determination of the actual smoke density or opacity being observed by trainees.

The systems now utilized consist of 2 smoke generating units,(3) each with a vertical stack and a density or opacity detection system (see Figures 4.4 and 4.5).

(1) Black Smoke System

Black smoke may be created by incomplete combustion of fuel oil or other liquid fuels; benzene is especially suitable for the purpose. The combustion chamber may consist of a steel box, perhaps 10 to 50 cubic feet in volume, lined with firebrick. Smoke density is varied by adjusting fuel flow rates, using a constant air supply rate. The combustion products are ducted to a cooling chamber, thence to the vertical stack from which the plume emerges. A forced-draft fan supplies dilution air at the base of the stack, providing adequate plume exit velocity to prevent excessive distortion by air currents.

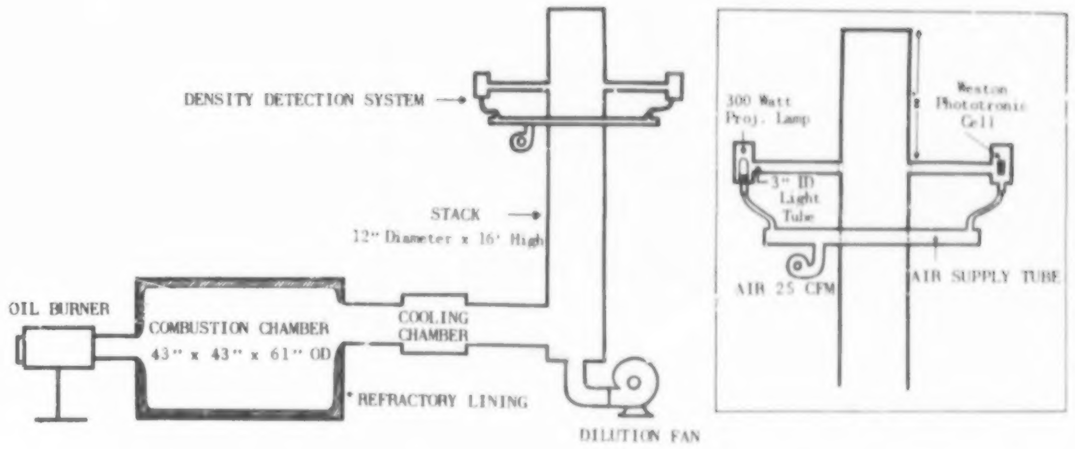

DENSITY DETECTION SYSTEM
STACK
12" Diameter x 16' High
OIL BURNER
COMBUSTION CHAMBER
43" x 43" x 61" OD
COOLING CHAMBER
REFRACTORY LINING
DILUTION FAN
300 Watt Proj. Lamp
3" ID Light Tube
8
Weston Phototronic Cell
AIR 25 CFM
AIR SUPPLY TUBE

Figure 4.4. DESIGN OF BLACK SMODE GENERATOR

(SOURCE: WEISBURD, Reference 3)

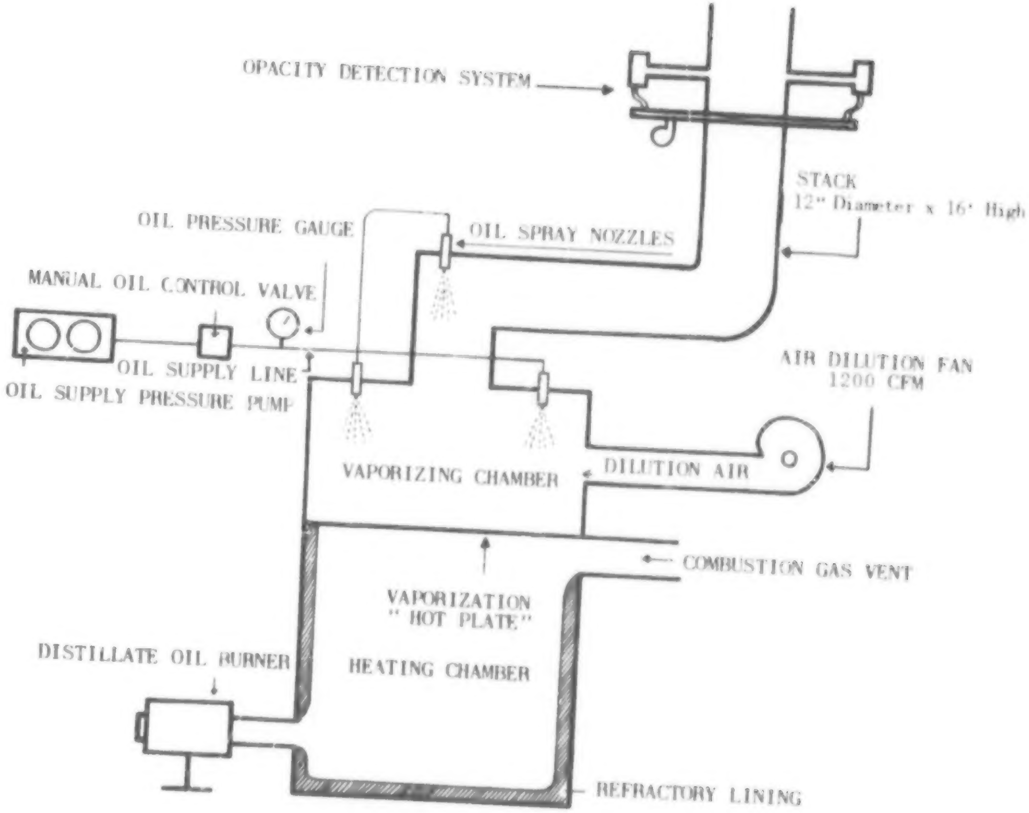

OPACITY DETECTION SYSTEM
STACK
12" Diameter x 16' High
OIL PRESSURE GAUGE
OIL SPRAY NOZZLES
MANUAL OIL CONTROL VALVE
OIL SUPPLY LINE
OIL SUPPLY PRESSURE PUMP
AIR DILUTION FAN
1200 CFM
VAPORIZING CHAMBER
DILUTION AIR
COMBUSTION GAS VENT
VAPORIZATION
" HOT PLATE"
DISTILLATE OIL BURNER
HEATING CHAMBER
REFRACTORY LINING

Figure 4.5. DESIGN OF WHITE SMOKE GENERATOR

(SOURCE: WEISBURD, Reference 3)

(2) White Smoke System

White smoke may be created by vaporizing a light distillate oil, such as number 2 fuel oil, and diluting it with air. The opacity is varied by adjusting the rate of supply of oil through a spray nozzle to the heated vaporization chamber, which may be, for example, an exhaust manifold of a gasoline engine. Again, dilution air maintains the necessary stack velocity.

(3) The Transmissometer System

The transmissometer, or opacity meter, consists of a simple light source and photocell combination, to measure the light transmission permitted by the particular smoke being produced. The percent transmission is read from a scale calibrated from 0 to No. 5 Ringelmann and 0 to 100 percent equivalent opacity. The light to photo-cell path is approximately 4 feet in length, but only 1 foot of length is exposed to the smoke. The remaining 3 feet are continually flushed with ambient air to prevent smoke buildup. The apparatus may be calibrated using neutral density filters.(7)

2. Training Procedure

Training in plume evaluation begins with the familiarization of the personnel with known densities of black and white smoke. Trainees are positioned at a reasonable distance from the plume—say, 50 feet. On signal, they observe the plume and are simultaneously or subsequently informed as to its opacity, as measured by the transmissometer. Variations in lighting and background color are introduced during such training runs, as familiarity with these effects may be critical to the accurate estimation of opacity.

In testing trainees for proficiency in plume evaluation, they are required to record (Figure 4.6) a series of readings, on signal, for comparison with unannounced transmissometer readings. The records are then evaluated by determining the average relative deviation of the trainee's readings from the true values. Satisfactory performance criteria, used by the Los Angeles County Air Pollution Control District, include an average deviation not exceeding 10 percent, with no individual deviations greater than 1 Ringelmann number (20 percent opacity).

Additional training is necessary if the trainee does not meet these standards. Analysis of the proficiency record may indicate whether the trainee is guessing and whether his readings are consistently too high or too low.

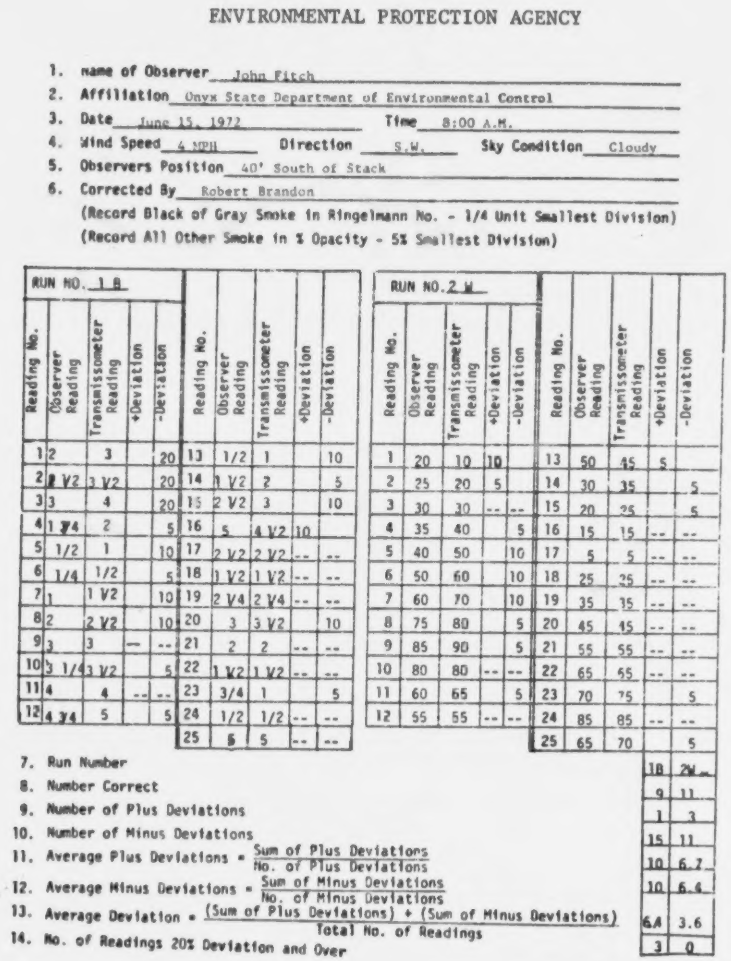
F. Reading Smoke in the Field

On the basis of the training given in the smoke school, and the accepted methods by which visual determinations are made, the following general rules (3) apply to sight-reading in the field. (See Figures 4.7, 4.8 and 4.9.)

1. Reading Air Contaminants

(1) Black smoke is read in densities and recorded in Ringelmann numbers.

(2) All other colored emissions are read in opacities and recorded in percentages.



ENVIRONMENTAL PROTECTION AGENCY

1. name of Observer John Fitch
2. Affiliation Onyx State Department of Environmental Control
3. Date June 15, 1972 Time 8:00 A.M.
4. Wind Speed 4 MPH Direction S.W. Sky Condition Cloudy
5. Observers Position 40' South of Stack
6. Corrected By Robert Brandon

(Record Black of Gray Smoke in Ringelmann No. - 1/4 Unit Smallest Division)
(Record All Other Smoke in % Opacity - 5% Smallest Division)

RUN NO. 1 B

Reading No.	Observer Reading	Transmissometer Reading	+Deviation	-Deviation	Reading No.	Observer Reading	Transmissometer Reading	+Deviation	-Deviation
1	2	3		20	13	1/2	1		10
2	2 1/2	3 1/2		20	14	1 1/2	2		5
3	3	4		20	15	2 1/2	3		10
4	1 3/4	2		5	16	5	4 1/2	10	
5	1/2	1		10	17	2 1/2	2 1/2	--	--
6	1/4	1/2		5	18	1 1/2	1 1/2	--	--
7	1	1 1/2		10	19	2 1/4	2 1/4	--	--
8	2	2 1/2		10	20	3	3 1/2		10
9	3	3	—	--	21	2	2	--	--
10	3 1/4	3 1/2		5	22	1 1/2	1 1/2	--	--
11	4	4	--	--	23	3/4	1		5
12	4 3/4	5		5	24	1/2	1/2	--	--
					25	5	5	--	--

RUN NO. 2 W

Reading No.	Observer Reading	Transmissometer Reading	+Deviation	-Deviation	Reading No.	Observer Reading	Transmissometer Reading	+Deviation	-Deviation
1	20	10	10		13	50	45	5	
2	25	20	5		14	30	35		5
3	30	30	--	--	15	20	25		5
4	35	40		5	16	15	15	--	--
5	40	50		10	17	5	5	--	--
6	50	60		10	18	25	25	--	--
7	60	70		10	19	35	35	--	--
8	75	80		5	20	45	45	--	--
9	85	90		5	21	55	55	--	--
10	80	80	--	--	22	65	65	--	--
11	60	65		5	23	70	75		5
12	55	55	--	--	24	85	85	--	--
					25	65	70		5

7. Run Number	1B	2W
8. Number Correct	9	11
9. Number of Plus Deviations	1	3
10. Number of Minus Deviations	15	11
11. Average Plus Deviations = $\frac{\text{Sum of Plus Deviations}}{\text{No. of Plus Deviations}}$	10	6.7
12. Average Minus Deviations = $\frac{\text{Sum of Minus Deviations}}{\text{No. of Minus Deviations}}$	10	6.4
13. Average Deviation = $\frac{\text{(Sum of Plus Deviations) + (Sum of Minus Deviations)}}{\text{Total No. of Readings}}$	6.4	3.6
14. No. of Readings 20% Deviation and Over	3	0

Figure 4.6. SMOKE SCHOOL TRAINING FORM

(SOURCE: Rom, Reference 6)

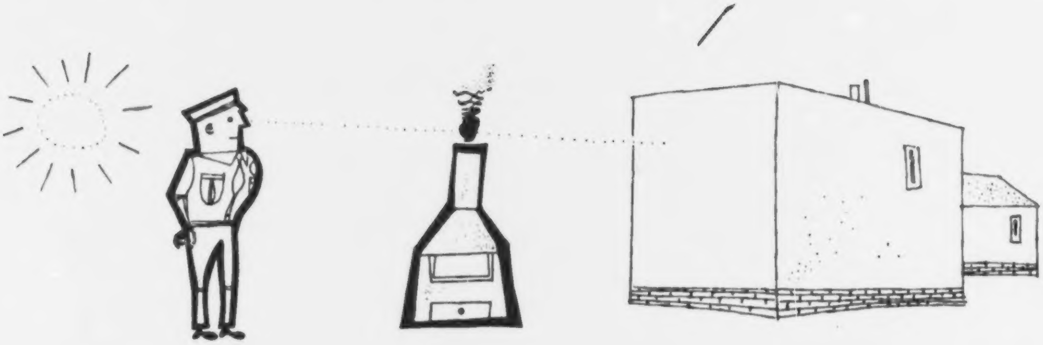


Figure 4.7. LIGHT SOURCE SHOULD EMANATE FROM THE REAR OF OBSERVER DURING DAYLIGHT HOURS (REFLECTED LIGHT)

(SOURCE: Weisburd, Reference 3)

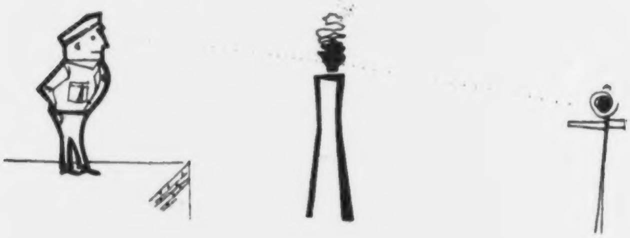


Figure 4.8. DURING DARKNESS, THE LIGHT SOURCE SHOULD EMANATE FROM BEHIND THE PLUME, OPPOSITE THE OBSERVER (TRANSMITTED LIGHT)

(SOURCE: Weisburd, Reference 3)

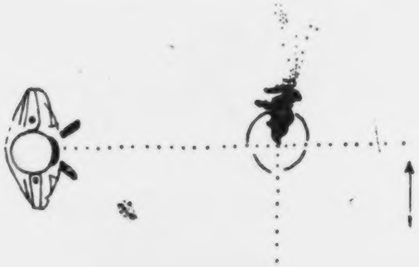


Figure 4.9. READINGS SHOULD BE MADE AT RIGHT ANGLES TO WIND DIRECTION AND FROM ANY DISTANCE NECESSARY TO OBTAIN A CLEAR VIEW OF STACK AND BACKGROUND

(SOURCE: Weisburd, Reference 3)

(3) All opacity readings are related to corresponding densities on the Ringelmann Chart in the following manner:

RINGELMANN	OPACITY
#1	20%
#2	40%
#2 1/2	50%
#3	60%
#3 1/2	70%
#4	80%
#4 1/2	90%
#5	100%

(4) Light source should be from rear of observer during daylight hours.

(5) Light source should be behind plume during hours of darkness (transmitted light).

(6) Readings should be made at right angles to wind direction and from any distance necessary to obtain a clear view of stack and background.

(7) An inspector should not study the plume as this will soon produce fatigue and cause erroneous readings. Instead, he should glance at the plume and record his observation immediately, looking away from the plume between readings.

2. Recording Air Contaminants

(1) Readings are recorded in the appropriate space on the report or notice form as taken.

(2) Observation times may be noted in terms of minutes and quarter-minutes, but not in terms of seconds except in extraordinary circumstances.

(3) Record all emissions during observation, showing consecutive changes in readings.

(4) Total only the time in which the emissions exceed the regulation.

(5) Color of visible emissions should be recorded as seen and as it changes.

(6) It is advisable to record all or a significant portion of the periods of excessive smoke observed during the inspection.

(7) A violation notice cannot be issued unless the source emitted excessive smoke for more than the legally specified time limit in any 1 hour. Continuing emissions should be recorded for at least 6 minutes of violation.

(8) Any 1 hour means any period of 60 consecutive minutes.

(9) Photographs should be taken before or after but not during visual determinations.

3. Smoke from Moving Sources

(1) Smoke from tailpipes and exhausts of vehicles is generally read in the same way that it is read from stationary sources. The observer following or pursuing a vehicle, however, should avoid reading directly into the plume, if possible. The line of observation should intersect the smoke trail at as wide an angle as possible. Error of reading smoke in this fashion should be compensated for.

(2) Smoke should be read at its point of maximum density.

(3) A stop watch should be used to record accumulated violation time.

IV. COLLECTING EVIDENCE

Much of the time spent by field enforcement personnel will be in the collection and reporting of data and evidence. In fact, most of the data collected by such personnel are of an evidentiary nature. Whether such data are used in an emission inventory or in the prosecution of a violation, they will consist for the most part of facts and findings acquired through direct observation. They should be stated in such a manner as to be clear, concise and free of prejudices and other subjective factors.

The data collected by an enforcement officer is written down on a report form. This report will be filed with, and used by, the enforcement agency, but is not usually submitted as evidence in any possible legal action. Should a field enforcement officer testify in court to the facts obtained by his observations and inspections, he will be examined directly, but may use his written report to refresh his memory. This type of evidence is designated as *testimonial evidence*. *Physical* evidence such as photographs, recorder charts, samples of fuel submitted and damaged materials may also be used.

A. Establishing the Prima Facie Case

To provide sufficient basis for court prosecution in a criminal case (such as where misdemeanor penalties are to be invoked) each and all the elements of the crime (in legal terminology, the *corpus delicti*) must be proved. To do so the enforcement office or other principal witnesses must gather the evidence for a prima facie case, i.e., a case which on the face of it shows guilt and which, unless rebutted, adds up to the commission of a violation of a rule or regulation. In a criminal court case the burden of proof of rebuttal is placed on the defendant after presentation of such evidence by the plaintiff (usually the people of the state).

Thus, if the rule alleged to have been violated is the prohibition that "a person shall not discharge into the atmosphere from any single source....any air contaminant" of any particular quality or quantity for more than the maximum permissible time specified, it must be proved that: (1) a person, (2) discharged, (3) into the atmosphere, (4) from a single source, (5) a contaminant, (6) of the quality proscribed (opacity or density), (7) for more than the time specified.

If any single element is missing (for example, it was not a single source), the corpus delicti is not established and there is no case.

B. Documentation of Evidence

The evidence required in court in order to establish a violation should be documented in carefully prepared reports. The information most commonly required is as follows:

- The nature and extent of the violation.
- The time and location of the violation.
- The person(s) responsible for the violation.
- The equipment involved with the violation.
- The operational, design or maintenance factors which caused the violation.

Further detail on each of these elements is treated below:

1. The Nature and Extent of the Violation

This element requires that the field enforcement officer determine the exact rule which has been violated. He must be familiar with all the rules he may be called upon to enforce in the field. This discussion is concerned largely with violations which are due to excessive emissions (all maximum permissible emission standards, including public nuisance).

The severity or extent of the violation must be determined before a violation of an emission standard can be demonstrated. The "extent" of violation refers to the degree of air pollution measured in terms of the specific standard in the rule, or the extent of non-compliance with the phrasing of the prohibition in the rule. Most rules stipulate a single standard of compliance. The "extent" in a smoke or opacity violation, for example, is measured in terms of the Ringelmann standard. In a violation relating to unauthorized construction of equipment, the extent is determined according to the date construction took place and the degree of completion.

The fact that a violation is observed must be accompanied, in the report, by the methods used to measure the extent of the violation. The procedures used in making visual determinations must be accurately recorded. For example, in the case of a smoke or opacity violation, the following data are required to confirm accurate use of the approved smoke reading method:

- Point of observation from source.
- Weather conditions during observation.
- Wind direction.
- Visible emissions observed showing continuous time intervals for each opacity and density, color change and total violation time in minutes.
- Status of plume at end of the recorded observation.

2. The Time and Location of the Violation

The exact date and time the violation occurred are a necessary element. The time of violation is generally noted in terms of (1) the time the field enforcement officer arrived to investigate the violation and the time he departed from the scene and (2) the specific time interval(s) of the violation.

The location is the actual address at which the violation was observed. The address must be given in terms of number and street. If the number is not known or available, the block number may be used with the street name. The street name must be given in full, (e.g., 105 Martin Ave., 2510 Burton Rd., 1010 So. Western Blvd.).

The city or community name must be that of the post office delivering mail to the location. Should the location of the violation be in unincorporated territory, the post office or other legal designation must be used.

3. The Persons Responsible for the Violation

The "persons" include all individuals responsible for the equipment by reason of legal operations and the individuals who may be responsible for the specific act which resulted in the violation. The persons associated with the violation will consist of the owners of the company and the employees immediately responsible. Court action in most cases is filed against the owners and sometimes against both the owners and the employees immediately responsible for the operation of the equipment, depending on the circumstances. In all investigations of violations, the field enforcement officer must report the name of the company, its form of ownership (company, partnership, individual, corporation, etc.), the highest authority contacted and the name and description of the employee or person operating the equipment at the time of the violation. The association of all persons involved, such as employee-employer relationship, etc., may be determined by direct interview.

4. The Equipment

The cause of the violation may often times be ascertained from the physical inspection of the source of emission or the equipment involved in the violation. The first important step in determining the cause of a violation is the location of the specific piece of equipment responsible. Equipment may be traced from the stack or ductwork, observed directly as the source or deduced through a process of elimination as the only possible piece of equipment capable of producing the plume observed. In other cases, the responsible piece of equipment may occur as one among several possible pieces of similar or identical equipment. In these cases the enforcement officer observes plant conditions closely for those operating cycles which result in excessive emissions.

The identification of the equipment consists of constructing a verbal description which positively identifies the source as a specific class of equipment capable of air pollution. The identification must do two things: (1) it must distinguish the exact piece of equipment from among all other equipment in the plant and (2) it must describe all of the important constituents of the equipment which affect the generation of pollutants, or which possibly qualify the permit status of the equipment. Below are listed some guide points which can be used in identifying equipment.

- The number of equipment units taken as the single source.
- The function or application of the equipment.
- The class or design category of the equipment, or the process in which it is used, or the materials fed, if these are pertinent to a positive identification.
- Size, charge or feed capacity of equipment, if these are pertinent.
- The commercial name of the equipment and the manufacturer's serial number, if any.
- Plant's equipment location number or relative or approximate location of equipment within the plant.
- Important equipment appurtenances which would qualify its permit status, such as type of heating element, blower

motors, etc., together with manufacturer's name and serial number.

- Other equipment serving or served by the equipment identified as the source.
- Description, manufacturer's name and serial numbers of all control equipment involved.

Examples of four types of source descriptions are shown below, based on the guide points listed above:

- One (1), horizontal return type, Smith Iron Works, Serial No. 2345, eastmost of two boilers, served by 2 Ray Rotary Cup oil burners, Serial Nos. 2000-1, 2000-2. Both boilers are breeched to a common 4-foot diameter x 30-foot high stack. Westmost boiler not in operation at this time.
- One(1), open fire, 5 feet diameter x 3 feet high, consisting of eucalyptus tree cuttings, tar paper, creosoted lumber, rubber tires, oil rig timbers and paint cans.
- Three (3), 350-pound, yellow brass, hydraulic tilt, melting furnaces, venting directly through one roof monitor, 20 feet long x 3 feet wide. Melt contains 14 percent zinc, poured at 2200°F. All furnaces in full operation at this time.
- One (1), local blower exhaust system, XYZ Pipe, ductwork, 24 inches diameter, 15 HP blower capacity, served by one 3-foot diameter cyclone, and serving 4 belt sanders, 1 sticker, 1 tenoner, 2 planers and 1 cross-cut saw. Only the belt sanders were in operation at this time.

Although the descriptions of the hundreds of different types of equipment vary considerably, the above 4 examples are sufficiently typical to illustrate the elements necessary in the proper description of the source of emission or the equipment involved in the violation. As will be noted, the identification may also include those design, process or operational characteristics which affect the air pollution problem. The notations of the brass furnaces include, for example, the amount of zinc melted and the pouring temperature. Also, in this example, the entire roof monitor is taken as the source and the important notation that all 3 furnaces were in operation at the time of observation is included. The findings may also include observations of emissions within the plant. In the last example, the list of equipment served by the blower system is important in determining cause, since the notation that only the sanders were operating may indicate that the cyclone is not efficient in collecting sanding dust alone. Similarly, in the first example the source is tied to 1 of 2 boilers, the eastmost, both breeched to 1 stack, since the westmost boiler, presumably used for standby purposes, was not in operation at the time of the inspection.

5. Operational and Maintenance Factors

The identification of the equipment logically leads to the next step in determining the actual cause of the violation. In some cases the identification will be sufficient. For example, in the case of excessive smoke (the second example), the fact that an open fire was conducted is in itself a violation of open burning restrictions. In these cases, that aspect of cause which relates to intent and responsibility of persons who ordered and lit the fire are most important.

In more complex cases, however, a more detailed explanation may be necessary. In refinery operations, for instance, schematics of flow processes and material flow with notations of vapor pressure and temperature, etc., are drawn to locate and estimate the possible losses of vapors and gases. In still other cases, the enforcement officer indicates, where appropriate, whether or not combustion equipment is operated at too high or too low a temperature in degrees Fahrenheit, as against normal operating temperatures, whether dampers are stuck, flame ports are blocked, or auxiliary burners for multiple-chamber incinerators are firing.

The enforcement officer checks the equipment and determines by interview and observation the actual conditions under which the equipment in question has been operated during the time of the violation. The cause of the violation may also be substantiated by statements made by the plant operator under interview, such as declarations regarding equipment failure, maladjustment, poor maintenance and variation in operating procedures. The causes which enter into each of the categories of violation, of course, vary.

C. Types of Evidence

The types of evidence used in court cases or administrative hearings include: (1) testimonial evidence, that is direct testimony by witnesses, (2) demonstrative evidence, or physical evidence used to support the testimonial evidence, and (3) evidence presented by expert witnesses.

The enforcement officer will be most concerned with the presentation of testimonial evidence as to observations made directly by him. Typical examples would include observations made on visible emissions, on odors, on presence or status of construction, on items of equipment, on process or operational conditions and on conditions under which he secured certain samples, such as fuel oil. He will often testify as to statements made directly to him by operators of equipment and plant owners, or by complainants. He may also testify on such external factors as atmospheric and weather conditions, including temperature, relative humidity, sky condition, visibility, lighting, and wind speed and direction. In some cases he will be called upon to interpret demonstrative evidence such as photographs. Testimonial evidence will also often be given by laboratory personnel reporting on pertinent tests that they have conducted.

Demonstrative evidence is almost any physical evidence used to support direct testimony. It may include damaged property or vegetation, samples of fuel or process materials, records of analyses and photographs. In many cases this type of evidence needs description or interpretation by an expert.

Damaged materials or vegetation samples may often be brought directly into a courtroom, provided the specimen is small enough to be transported or the damage pattern is not altered or disturbed. In some cases, test specimens may be placed in a preplanned pattern around the suspected source and retrieved for laboratory examination after a suitable time for exposure. These specimens could include test fabrics of differing materials and dyestuff, metal plates and greased glass slides or plates. In some cases the damage pattern may be apparent to even the casual observer such as a gross deposit of a material readily identified by eye. Most often, however, testimony of an expert witness will be required. In some cases supplementary evidence such as photomicrographs and laboratory analyses will be necessary.

Test data may include reports of source analyses, ambient sampling conducted in the vicinity of a source and on materials charged to the process in question. Source tests may range from rather simple tests for solid particulates at the process discharge to complex multi-point sampling for a variety of particulates, gaseous contaminants and ancillary data such as flue gas composition, temperature and moisture content. Environmental sampling data collected in the vicinity of a source may include reports of analyses from manually operated sampling devices or recorder charts from continuous analyzers. Recorder chart data which can be correlated with the time of complaints and with meteorological data, such as wind speed and direction and atmospheric stability, can be very useful.

Analyses conducted on process materials or fuels might include sulfur and ash content of fuels, metal charge composition, particle size distributions and composition of incinerator feed.

Photographic evidence is usually used to give a graphic illustration of descriptions presented in direct testimony. Examples might include still or motion pictures of visible stack effluents; photographs showing the construction status of equipment, illustrating the condition of control equipment, or showing the effectiveness of fume hood pickup; pictures of damaged materials, and photomicrographs of finely divided particulate matter.

V. COMPLAINT HANDLING

Complaints against general air pollution conditions or specific sources of air pollution are either reported to field personnel, reported in correspondence or phoned into the air pollution control agency. Complaints are frequently communicated by phone at or near the time of some kind of air pollution incident or episode.

A. Receiving the Complaint

The switchboard operator of the agency determines whether the complaint is concerned with a specific source or with general smog conditions. It it is the former, the call is forwarded to the appropriate member of the enforcement staff or to a dispatch center.

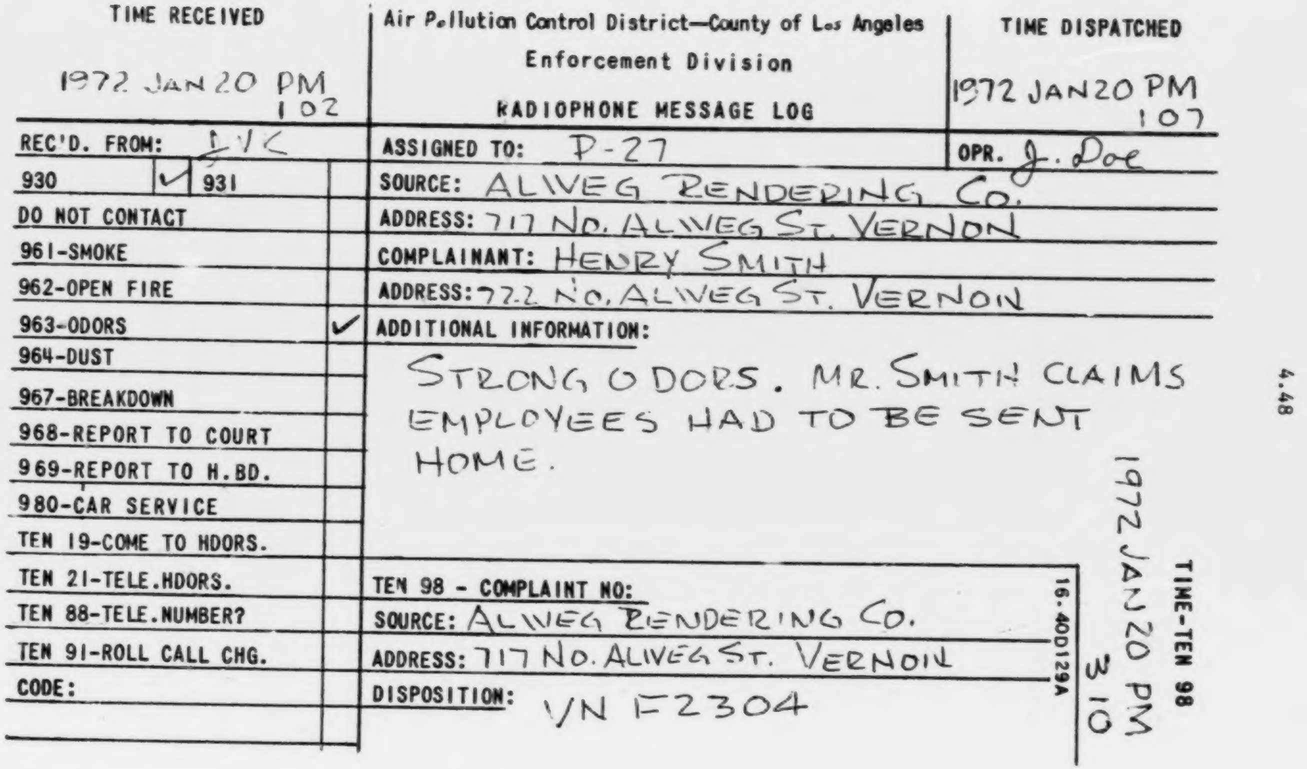
The names and addresses of the source and the complainant are noted on a message log (Figure 4.10). The validity of the complaint as well as the nature of the problem are determined. In some instances, it is unnecessary to dispatch an enforcement officer since the location may already be under investigation. In other cases the source may already have been reported by the enforcement officer in the field.

If enough facts are obtained to dispatch the enforcement officer either to a specific source location or to the complainant, investigation is warranted.

After the message log is completed, a complaint number is assigned, the time is stamped on the log and a field enforcement officer is dispatched immediately to the scene. Complaints are investigated as speedily as possible to ensure that the reported source may be reached while the violation or nuisance is still in progress.

B. Complaint Investigation

Upon arrival in the vicinity, the enforcement officer first observes the alleged source to determine if a violation is involved. If a violation is observed, he investigates, writes and serves a notice, if warranted. Then he visits the complainant. However, if no violation is immediately apparent, the complainant is contacted.



TIME RECEIVED

1972 JAN 20 PM
102

Air Pollution Control District—County of Los Angeles
Enforcement Division
RADIOPHONE MESSAGE LOG

TIME DISPATCHED

1972 JAN 20 PM
107

REC'D. FROM: LVC

930 ☑ 931

DO NOT CONTACT	
961-SMOKE	
962-OPEN FIRE	
963-ODORS	✓
964-DUST	
967-BREAKDOWN	
968-REPORT TO COURT	
969-REPORT TO H.BD.	
980-CAR SERVICE	
TEN 19-COME TO HDQRS.	
TEN 21-TELE.HDQRS.	
TEN 88-TELE.NUMBER?	
TEN 91-ROLL CALL CHG.	
CODE:	

ASSIGNED TO: P-27

OPR. J. Doe

SOURCE: ALWEG RENDERING CO.

ADDRESS: 717 NO. ALWEG ST. VERNON

COMPLAINANT: HENRY SMITH

ADDRESS: 722 NO. ALWEG ST. VERNON

ADDITIONAL INFORMATION:

STRONG ODORS. MR. SMITH CLAIMS EMPLOYEES HAD TO BE SENT HOME.

TEN 98 - COMPLAINT NO:

SOURCE: ALWEG RENDERING CO.

ADDRESS: 717 NO. ALWEG ST. VERNON

DISPOSITION: VN F2304

16-40D129A

TIME-TEN 98

1972 JAN 20 PM
310

Figure 4.10. EXAMPLE OF RADIOPHONE MESSAGE LOG

The enforcement officer makes every effort possible to avoid obvious identification of the complainant. He is particularly careful not to park his official vehicle too close to the complainant's residence should the complainant and the source be near each other. The identities of all complainants should be considered to be confidential and should not be disclosed to anyone who is not an employee of the enforcement agency.

If the complainant is not at home the enforcement officer should leave a message. If the complainant is at home, the enforcement officer identifies himself by name and agency in a friendly manner, and proceeds with the interview.

The enforcement officer is friendly, but dispassionate. He generally employs a "non-directive" interview technique in that he allows the complainant to get the matter off his chest so that the facts of the situation can be calmly discussed. He should also appreciate the fact that a person who is angry may be honestly motivated by a serious or chronic air pollution condition.

In permitting the complainant to speak his mind, it is well for the enforcement officer not to interrupt. It is particularly effective, however, that when facts appear the officer repeats them aloud for verification and then jots them down.

After the complainant has expressed himself, the enforcement officer then proceeds on a line of questioning which will (1) determine the cause of the complaint and (2) the nature and source of the air pollution problem cited in the complaint. The line of questioning in this case is intended to complete and verify the data supplied by the complainant.

The cause of the complaint may not always involve air pollution. Although most complaints are justified, some will concern problems over which the agency has little or no control and in which air pollution may play a minor role. These concern backyard feuds, natural contaminants, resentment towards a nearby company or low concentrations of contaminants which may affect illness or allergy in an individual. Although the enforcement officer may have no legal powers in such cases, he thoroughly investigates and attempts to correct all air pollution problems. If such complaints are unsubstantiated, he establishes the cause of the complaint and documents the fact that no violation has occurred by recording the operational data of the equipment at the alleged source.

In order to obtain the necessary data, the following should be obtained:

(1) Name and location of source complained of.

(2) Frequency of annoyance or occurrence of plume.

(3) Time of day nuisance was first noticed.

(4) Duration of nuisance at each occurrence.

(5) Names and addresses of persons affected.

(6) Location and extent of property damage, if any.

(7) Description and frequency of any illness alleged to have resulted from the air contaminants.

(8) Description of odors, if any involved.

(9) Any other information the complainant may have that will relate the nuisance to a specific piece of equipment.

In an air pollution problem which appears to involve toxicity, the enforcement officer records all observed or reported symptoms such as:

- nausea
- vomiting
- headache
- eye-irritation
- fever
- constriction of chest
- eye tearing
- soreness of throat
- nasal discharge
- turning blue
- cough
- difficulty of breathing, etc.

If the symptoms appear serious, a physician and the health authorities should be contacted. The enforcement agency should also be immediately notified in order that an emergency vehicle may be dispatched to the scene to measure the concentrations of any possible toxic contaminant.

It should be noted that only a physician can make a diagnosis. The enforcement officer records reported symptoms in his report. The enforcement officer can note the name of the physician conducting the diagnosis and treatment. This information is important if public nuisance action should be initiated.

While interviewing complainants, the enforcement officer does not promise legal action nor does he commit himself or the control agency to any course of action. He should, however, explain to the complainant the laws involved and the evidence required to instigate legal proceedings. But he will also explain that he will first attempt to seek cooperation on the part of those who may be responsible.

If odors, soiling or other property effects are involved, the enforcement officer examines the citizen's property. The pattern of fall-out of contaminants may indicate the direction from which they came. If a malodor is detected at the complainant's property, the wind direction can be determined for the purpose of tracing the odor to its source.

As a rule, enforcement officers do not solicit opinion in a neighborhood regarding the behavior of any plant, but confine themselves to those persons volunteering complaints. It is usually citizens who do the canvassing and who supply the information. The enforcement officer may then interview all complainants involved. The canvassing of complainants is usually discouraged. The enforcement officer does not sample, nor act on, opinion, but on sincerely motivated complaints. The canvassing of the neighborhood can be construed in a court of law as being prejudicial to the plant.

The enforcement officer, on the basis of his knowledge of air pollution, however, evaluates the consistency, correspondence and intensity of remarks made by possible witnesses. He attempts to find some degree of unanimity regarding the objectionability of the problem among those who might be equally affected. Diverse opinions and inconsistencies are first signs that a public nuisance case may not be easily developed.

C. Inspection of the Source

From the facts gathered so far, the enforcement officer may have a notion of the specific or type of source responsible, especially if he has identified contaminants and has observed definite evidence of damage or detected odors on the complainant's property. In other cases, he may know the identity of the contaminants, but not the source of origin. In still other cases, the contaminant may be completely unknown.

To establish a public nuisance, a source within a certain facility responsible for the offending emission must be proved. In some cases, the equipment involved may be obvious; in others, especially in a plant containing many pieces of equipment, the source may be difficult to locate. In the latter instance, each piece of equipment must be inspected in detail. Those which do not contribute to the problem are eliminated from consideration.

Quite often the job is completed if the complaint or nuisance also involves a violation of the rules and regulations through the emission of contaminants in excess of that allowed, or through the operation of unpermitted equipment, or through operation of equipment contrary to permit conditions. In these instances, the action to be taken is indicated.

If, however, the nuisance is a result of quantities of air pollution which are allowed by quantitative standards in the Rules and Regulations, a public nuisance will have to be proven.

When the enforcement officer contacts the plant operator, he explains that he is investigating a complaint, unless, in the individual instance it should be strategic not to do so. The enforcement officer may also explain that he is trying to determine whether or not the complaint is justified. This gives management the opportunity to state its case, since it knows that the enforcement officer is not yet committed to any action. As with the complainant, he is also attentive and takes notes. Then, on the basis of the information he acquires from the complainants, he asks developmental questions and completes the story. He then inspects the equipment and compares actual operating conditions, cycles and times of operation with the times and frequencies of complaints.

1. Mediation

Because the enforcement officer is an indifferent observer between 2 parties in conflict, he has a natural tendency to act as mediator and will attempt to find that solution to a problem which will satisfy both the complainant and the operator. For example, if the complaint is made of an operation conducted in the evening when the complainant is at home, the operator may agree to shift the operation to a daytime schedule. The company may also agree to relocate equipment, put a spark arrestor on an incinerator stack, raise a stack and even eliminate a process unessential to the business activity as a means of becoming a "good neighbor," if these acts do not involve violations of the rules and regulations. It is important, however, that such agreements do not compromise the law. The enforcement officer does not agree to a maintenance of a violation.

2. Nuisance Action

The most difficult type of air pollution case is the public nuisance. A public nuisance frequently occurs when a number of persons are annoyed by a quantity of contaminants which is otherwise allowed. The problem in cases of alleged public nuisance is to determine whether a private dispute or a valid public dispute is involved. If a private dispute is involved, then the citizen must initiate his own legal action. A public nuisance, however, involving a "considerable number of persons" or a reasonable cross-section of the immediate community affected is handled as an enforcement action.

Once the enforcement officer determines that a public nuisance is involved, he must assume an attitude of objective indifference since the rights of the company to maintain the alleged nuisance, and the rights of the citizens to be rid of it, constitute a conflict in equities which may only be resolved in court. The burden of proving the public nuisance ultimately rests on the testimony of the complainants themselves. The enforcement officer is also a witness in that he can, in his opinion, verify the existence of the nuisance.

The appropriate legal forms are completed and signed by the complainants in their own handwriting. These documents, together with enforcement officer's findings, may be filed as a violation in the courts to test whether or not a public nuisance exists.

VI. FIELD EVALUATION AND ENFORCEMENT EQUIPMENT

In the process of evaluating air pollution problems in the field, field enforcement officers can be most effective when aided by various types of equipment, as described below.

A. Mobility and Personal Protection

The first requirement for mobility is an automobile. Enforcement vehicles should be equipped with 2-way radio communication.

Control agencies should have the capability to respond to emergencies. Some agencies use vehicles equipped as emergency vehicles including sirens and flashing lights. Other agencies seek cooperation from fire and police departments.

Under routine conditions, the automobile serves to transport the enforcement officer and his equipment quickly to any routine or special assignment.

Personal protection is necessary in many of the industrial locations an enforcement officer may be required to visit. Although many industrial firms are prepared to provide such equipment for visitors on request, much time may often be saved by equipping each enforcement officer with permanently issued items such as safety hats, safety glasses or goggles, steel-toe shoes, ear plugs for sound attenuation, heavy gloves and gas masks or canister-type respirators.

B. Facilitating, Verifying or Recording Observations

For assistance in gathering evidence in the field, it is useful to have an inspection kit which includes the following items: camera, binoculars, stop watch, flashlight, maps, compass, smoke tube, required forms and miscellaneous accessories.

Cameras are used primarily to photograph excessive emissions from stacks and vehicles and to photograph equipment and operating personnel for identification purposes. Cameras which permit rapid development of photographs at the site of an investigation are especially useful. Moving picture cameras may be desirable for special investigations.

Stopwatches should be of the accumulative type for use in recording total time of excessive emissions within a given period of observation.

C. Assessment of Weather Conditions and Measuring Ambient Air Flow

Data relevant to determining the speed and direction of dispersion of contaminants in the atmosphere include temperature, humidity, wind speed and wind direction. Such measurements are continuously provided at weather observing stations, but may be required at other locations during special investigations.

Equipment suitable for such purposes includes various types of thermometers; some psychrometers, especially the "sling psychrometer;" and various anemometers or "wind gauges." Such equipment has recently been discussed in detail by Hewson.(7) For measuring surface wind speeds, rotation anemometers are most satisfactory, on the whole; a particularly convenient type is the totalizing cup anemometer, in which the passage of each 1/10 or 1/60 mile of wind and each 1 mile of wind past the instrument is counted and recorded. Other anemometers are based on the use of pitot tubes or vanes to register pressure differences caused by wind, and on the use of electrically heated elements which are cooled by wind. Such devices are likely to prove more convenient for measuring air flow in controlled systems, such as ducts and exhaust hoods than for the open atmosphere.

D. Measurement of Process Air Stream Flow

For checking flow in exhaust systems, air velocities are determined by instruments similar to those described above, but usually without orienting vanes. Careful determination of velocities in ducts requires the use of a pitot tube, with a considerable degree of engineering expertise.(8) A standard pitot tube (Figure 4.11) consists of 2 concentric tubes: the inner tube measures the impact pressure, which is the sum of the static and kinetic pressures, while the outer tube measures only the static pressure. When the

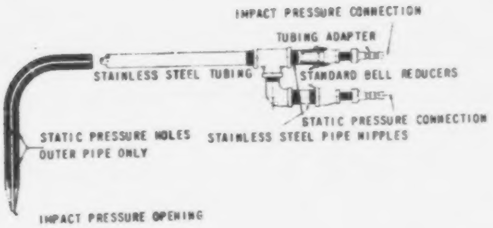

IMPACT PRESSURE CONNECTION
TUBING ADAPTER
STAINLESS STEEL TUBING
STANDARD BELL REDUCERS
STATIC PRESSURE CONNECTION
STATIC PRESSURE HOLES
OUTER PIPE ONLY
STAINLESS STEEL PIPE NIPPLES
IMPACT PRESSURE OPENING

Figure 4.11. STANDARD PITOT TUBE (WESTERN PRECIPITATION, DIVISION OF JOY MANUFACTURING CO., LOS ANGELES, CALIF., FROM ASHRAE GUIDE AND DATA BOOK, 1963)
(SOURCE: D'Imperio, Reference 8)

Two tubes are connected across a U-tube manometer or other suitable pressure-measuring device, the static pressure is nullified automatically and only the velocity pressure (kinetic pressure) is registered. The velocity is correlated to the velocity pressure by the equation:

$$v = 1096.5 \sqrt{\frac{h_v}{\rho}}$$

where

v = velocity, fpm
h_v = velocity pressure (manometer reading), in WC
ρ = density of air, lb/ft^3

Clearly, below 1,266 fpm, the velocity pressure becomes extremely low and is, therefore, difficult to read accurately on a manometer. With a U-tube manometer, the accuracy is low for velocities below 2,500 fpm. With a carefully made, accurately leveled, inclined manometer, velocities as low as 600 fpm can be determined satisfactorily, but field conditions ordinarily make this procedure difficult (*ASHRAE Guide and Data Book*, 1963). A more convenient velocity meter, incorporating a swinging-vane pressure indicator, is described in detail by D'Imperio.(8) The factors that make the swinging-vane velocity meter an extensively used field instrument are its portability, instantaneous reading features and wide-range scale. The instrument is fairly rugged and its accuracy is suitable for most field velocity determinations.

The meter consists of a pivoted vane enclosed in a case, against which air exerts a pressure as it passes through the instrument from an upstream to a downstream opening; movement of the vane is resisted by a hair spring and damping magnet. The instrument gives instantaneous readings of directional velocities on the indicating scale.

E. Sampling Contaminants in Ambient Air and Process Streams

Estimates of pollutants are made in the field by means of commercially available portable test devices. Table 4.1 lists some gaseous air pollutants which can be easily detected by means of these devices.(3) The devices shown are among the numerous ones on the market today.

"Grab samples" are often obtained by filling gas sampling tubes or inert plastic bags with air by means of motor or hand-powered pumps. The collected air sample is analyzed in the laboratory.

Table 4.1. CONTAMINANTS WHICH CAN BE TESTED IN THE FIELD WITH PORTABLE DEVICES

CONTAMINANT	REASON FOR TESTING OR SOURCE TEST	REAGENT OR EQUIPMENT USED	TREATMENT OR REACTION OBSERVED	TIME REQUIRED			CONCENTRATION RANGE OF TEST	EIGHT HOUR[33] THRESHOLD LIMIT	SUFFICIENT WARNING WITHOUT TESTING
				a	b	c			
Aldehydes	Eye Irritation Complaints	Absorption in Sodium Bisulfite M.S.A. Midget Impinger	Iodometric Titration	10	5	10	0 - 1000 ppm	.5 to 5.0 ppm	Yes — Eye Irritation
Ammonia	Odor Complaints	Red Litmus & Stop Watch	Color Change to Blue	1	1	0	10 - 100 ppm	100 ppm	Yes — Odor
Aromatic Hydrocarbons		M.S.A. Aromatic Hydrocarbon Detector	Colors. Treated Granules. Stain Length Measured						
1. Benzene	Odor Complaints	" "		10	2	0	0 - 100 ppm	25 ppm	Yes — Odor
2. Toluene	" "	" "	" "	10	2	0	0 - 400 ppm	200 ppm	Yes — Odor
3. Xylene	" "	" "	" "	10	2	0	0 - 400 ppm	200 ppm	Yes — Odor
4. Styrene	" "	" "	" "	10	2	0	Qualitative	100 ppm	Yes — Odor
Arsine	Odor Complaints Plating Operations	M.S.A. Arsine Detector	Treated Filter Papers Change Color	10	2	1	0 - 100 ppm	0.05 ppm	No
Carbon Dioxide	Exhaust Complaints	Fyrite CO_2 Analyzer	Absorption in Caustic & Measure Vol. Change	1	3	0	0 - 20%	5000 ppm	No
Carbon Monoxide	Exhaust Complaints	M.S.A. CO Detector	Colors. Treated Granules — Color Change	1	2	2	0 - 1000 ppm	100 ppm	No
Chlorine	Cylinder Loading & Bleach Mfg.	O-Tolidine in the M.S.A. Midget Impinger	Color Intensity Compared to Standards	10	5	2	0 - 70 ppm	1 ppm	Yes — Odor for Immediately Dangerous Levels No — for Low Conc.
Combustible Gases	Venting Storage Tanks Odor Complaints	M.S.A. Model 40 Combustible Gas Indicator	Direct Reading Instrument	1	2	2	0 - 20 x LEL	—	Some Yes — Odor
Hydrocyanic Acid Gas	Plating Processes	M.S.A. Hydrocyanic Acid Gas Detector	Treated Granules Change Color	10	2	0	0 - 50 ppm	10 ppm	Yes — Odor — by Trained Personnel
Hydrogen Fluoride	Phosphate Rock	M.S.A. Hydrocyanic Fluoride-in-air Detector	Treated Filter Papers Change Color	5	5	0	.5 - 5 ppm	3 ppm	Yes — Odor for Immediately Dangerous Levels No — for Low Conc.
Hydrogen Sulfide	Odor Complaints Refineries and Chemical Processes	M.S.A. H_2S Detector	Treated Granules Change Color	1	2	0	0 - 50 ppm	20 ppm	No — Odor Is not Reliable
Nitrogen Dioxide	Atmospheric	Saltzman Reagent	Color Change Measured	1	1	d	0 - 10 ppm	5 ppm	Not Reliable
Ozone	Safety Level from Air Purifiers	Rubber Cracking	Time Interval of Cracking Measured	10	20	2	0 - 100 ppm	10 pphm	No
Oxygen Deficiency	Closed Vessels or Room	Fyrite Oxygen Analyzer	Absorption Measure Volume Change	5	5	0	0 - 21%	18 - 21%	No
Phosgene	Thermal Decomposition of Organic Halides	Treated Filter Papers	Color Change Compared to Standards	5	5	1	1 - 100 ppm	1 ppm	No
Phosphine	Mfg. of Acetylene	Treated Granules	Color Stain Length Measured	5	5	2	1 - 10 ppm	5 pphm	No
Sulfur Dioxide	Complaints	M.S.A. SO_2 Detector Treated Granules Reich's Test Tutweiler	Length of Bleaching Action Measured Gas Titration Gas Titration	10 10 10	2 10 10	0 5 5	1 - 150 ppm 0 - 1000 ppm 50 Grains/ft³	5 ppm	Yes — Odor

a. Preparation in minutes
b. Test or Sampling
c. Calculation and Interpretation
d. Laboratory Analysis

(SOURCE: Weisburd, Reference 3)

Absorption techniques are available whereby quantitative estimation of gaseous pollutants can be made easily by using bubblers and reading with photometer or pH meters.

Systems used for the collection of particulate contaminants include sedimentation and settling devices, such as fallout jars and gummed paper stands, miniature cyclone collectors, blower and filter systems, impingers and impactors, electrostatic samplers and thermal precipitators. It is becoming more important to obtain size-discriminating samplers in place of total mass samplers.

The sampling of gaseous contaminants involves separating them from the air in which they are entrained. Such techniques are adapted either to the sampling of specific gaseous compounds or to the determination of gross total concentrations of gaseous contaminants. Specific methods are available for sampling for many inorganic gases and some reactive organic compounds. In most cases these methods involve absorption by bubbling the air through a reactive liquid agent. Mixed gases are usually trapped by adsorption or freezeout techniques. In any event an appropriate sampling train must be devised, usually augmented by a suction pump and a meter (either a wet or a dry gas meter).

For sampling of liquid fuels, as may be required in order to enforce fuel composition regulations, special containers approved for flammable liquids may be required. Fuel oils of low volatility can be collected in quart or half-gallon tins.

F. Equipment for On-the-Spot Testing

At times, the enforcement officer will be called upon to make quick, and sometimes crucial, estimates of air pollution problems in any environment. While he cannot make accurate determinations of concentration on the basis of sense perceptions only, he may be able to identify pollutants, allow for hazardous concentrations and trace them to a logical source. In order to eliminate guesswork and to establish identity and concentration within a reasonable degree of accuracy some field sampling equipment is required. Such equipment, to be of use in enforcement, must be portable, require a minimum amount of equipment and field preparation, be of a direct-reading type, yet be substantially accurate.

In a petroleum refinery surveillance program, on-the-spot testing may be conducted by teams manning specially equipped emergency test vehicles. Radio-equipped automobiles are especially useful in tracing and identifying transient emission sources which may be otherwise difficult to locate. A noxious or malodorous gas may originate from almost any point and spread over an entire community. A test car can be dispatched to the scene in a short time. The inspector manning the car is skilled in the use of the testing equipment and is prepared to test for the contaminant and trace it quickly to its source.

Noxious gases, odors, vapors and phenomena for which tests can be made in the field and which require no collection of samples for laboratory analysis are aldehydes, ammonia, aromatic hydrocarbons (benzene, toluene, styrene, xylene) atomic radiation, carbon dioxide, carbon monoxide, chlorine, combustible gases and vapors, organic halides, humidity, hydrogen cyanide, hydrogen sulfide, mercaptans, oxygen (deficiency) and sulfur dioxide.

Operation of such equipment is beyond the scope of this manual. Instructional manuals are issued with the equipment on purchase.

Testing equipment is added to test vehicles when proven to be reliable. The reagents and equipment used for testing as well as concentration ranges and thresholds are shown in Table 4.1. This equipment includes the following:

(1) Test Papers

Certain types of simple sensitized papers will change color in the presence of physiologically significant concentrations of noxious gases, fumes or dusts. These can be used to test for or to verify the existence of certain suspected contaminants such as ammonia, hydrogen sulfide and phosgene. For example, ammonia reacts with litmus to produce a red to blue color change. Concentrations of ammonia from 0 to 1,000 ppm can be detected by this method. Similarly, hydrogen sulfide may be detected with lead acetate, phosgene with diphenylamine, etc.

(2) Squeeze Bulbs and Ampules

These generally consist of 2- or 3-ounce squeeze bulb aspirators and glass tube ampules packed with impregnated granules. These granules stain, color or bleach in specific gas/solid reactions. The reagent in the granule surfaces gives colorimetric reactions when contaminated air is drawn through them. These are commercially available as are the mine safety appliance gas testers constructed for specific contaminants, as shown in appropriate places in Table 4.1.

(3) Tutweiler Apparatus

This apparatus is used to determine concentrations above 150 ppm of hydrogen sulfide, sulfur dioxide, ammonia and carbon dioxide in stack analyses, etc., by gas/liquid titrations. The apparatus consists of a 110 ml. burette serving as a gas/liquid reaction chamber with a leveling bottle, and a 10 ml. graduate mounted on top of the burette through a two-way cock. The third outlet of the cock, the gas inlet tube, is open to the atmosphere to be tested or connected by a tygon tube to the gas sample.

(4) Reich's Test

This test is performed specifically to make volumetric determinations of SO_2 by gas/liquid titration. A metered amount of contaminated air is bubbled through a solution of water, iodine and starch in a graduated cylinder until a color change is observed. An amount of iodine equivalent to .2 percent of SO_2 in 1000 ml. of air is used in the solution, providing a calibration point.

(5) Midget Impingers and Gas Absorption Cells

These are used for collecting particulate matter, aerosols and mists and are aspirated with a small 6" x 10" x 5" hand-operated pump, as in the case of the M.S.A. midget impinger. These employ the impingement principles described earlier in this chapter. The samples collected are analyzed in the field.

(6) Halide Leak Detector

This equipment is used for the determination of the concentration of halogenated hydrocarbon vapors such as Freon, carbon tetrachloride, trichlorethylene and perchlorethylene. It consists of a small LPG fuel tank fitted with a microburner that has a copper ring reaction plate above the flame tip. A rubber tube sampling line feeds the contaminated air to the burner by natural draft. The flame color for a specific contaminant at an unknown concentration is compared with a color chart to estimate the concentration.

(7) Measurement of Volume Change

These include principally the Fyrite CO_2 and O_2 analyzers shown in Table 4.1. Carbon dioxide is measured by the volume change resulting from absorption in caustic and oxygen by absorption in pyrogallic acid.

(8) Explosimeters or Combustion Meters

These are used for testing combustible gases, i.e., carbon monoxide, natural gas, hydrocarbon vapors, similar to the explosimeters used by the gas companies. A metal tube probe is connected to the portable meter by a length of rubber tubing. The meter is operated on self-contained batteries and uses a squeeze bulb to aspirate samples through the reaction chamber.

(9) Geiger Counters and Ion Chambers

These are for use in radiological monitoring in the field in the event of disaster. In some agencies enforcement personnel are trained to use them, and vehicles are equipped with them, pursuant to responsibilities assigned to the agency for civil defense and disaster preparedness programs.

G. Fuel Sampling

In some instances it is desirable to sample and test liquid, solid or gaseous fuels in the field, particularly to test compliance with fuel composition regulations. Such rules may, for example, limit the sulfur and ash content of solid and liquid fuels, the sulfur content of gaseous fuels, including refinery make-gas, and lead content and olefin content in, and organic vapors from, petroleum products and gasoline and other motor vehicle fuels to be marketed in the community. Some instances of field testing are as follows:

1. Gaseous Fuel

To determine compliance with such rules regarding gaseous fuels two separate tests are required: (1) determination of heat value (Btu) and (2) determination of sulfur loading.

Two types of refinery gas fuels will require the enforcement officer's attention. These are: (1) refinery "make" gas derived from light ends from processes and sweetened or diluted in mixing drums and (2) refinery waste gases generally arising from tail gases from H_2S absorption and waste water stripping systems, or any gas which is not diluted and sweetened.

"Make" gas in refinery fuel distribution systems generally has a heat value in excess of 300 Btu. Sulfur loading tests are conducted routinely and especially upon observance of a visible plume.

The waste gas, on the other hand, should be tested for heat value and sulfur loading. The pressure gauge is removed from the waste gas line and a probe connected to a combustible gas indicator is inserted for testing of heat value. The combustible gas indicator acts as a thermocouple that has been previously calibrated for on-scale readings by use of a proper size dilution orifice.

If the gross heating value exceeds 300 Btu/ft^3, then the sulfur loading must be determined. The testing is accomplished in the field by applying an H_2S tester which gives colorimetric reactions. The H_2S tester is applied at the pressure gauge of the waste gas line by means of a nipple, adaptor and a T-joint whenever the waste gas fuel line is under greater than atmospheric pressure. The sulfur loading of this gas is determined by measuring the length of the stain on the impregnated granules. If the reading is in excess of 25 grains with 5 squeezes of the bulb, an excess of 50 grains is indicated. A sample should be taken to the laboratory to determine actual grain loading so that the necessary enforcement action can be taken.

Waste gases under less than atmospheric pressure, usually those originating from sour water stripping operations and introduced into combustion zones by jet or stream injection, must be sampled in an evacuated gas sample bottle adequately equipped with stop cocks applied to the line by means of a straight adaptor. The sample is then brought to the laboratory for analysis.

2. Liquid and Solid Fuels

To determine compliance with rules for solid or liquid fuels an adequate sample must be collected from the fuel line or supply and taken to the laboratory for analysis to determine sulfur loading of the fuel.

Assuming that equipment is in good order and is being operated correctly, a visible emission is a good indication that this rule is being violated. A sample of the fuel should then be taken.

Excessive sulfur content in liquid or solid fuels may be suspected, also, by the known specifications of the fuel being used. Fuel specifications are given in terms of:

Grade
Description
Bunker No.
API Gravity
Specific Gravity °Be[1]
Btu/lb.
Dens. lb/Gal.
Specific Gravity

The specific sulfur content should be ascertained from purchase receipts or through inquiry.

If the enforcement officer cannot, through interview of the operator or examination of fuel oil receipts, determine the API gravity, he ascertains some other fuel specification which he correlates with sulfur content. If he is in doubt and cannot acquire any specifications, he should take a sample. Fuel oil should be sampled with an "oil thief" and collected in 1- or 2-quart tins. A coal shovel is used to sample coal or other solid fuels from chute feeding systems. Sampling techniques are further described in Fuel-Burning Equipment, Chapter 6, Section IIG.

VII. COMMUNICATIONS EQUIPMENT

An important aid to the detection and control of the sources of air pollution is the use of a radio-communications system for the instruction, dispatch and location of all field units. This equipment is required to operate for the following reasons:

(1) Need to enforce emergency prevention regulations.

(2) Necessity to reach complainants and violators quickly to obtain the essential evidence.

(3) Field units require certain types of data needed to execute their assignments. Such information may pertain to the status of variances or breakdowns which have been reported to the agency.

(4) Headquarters may require the immediate disposition of any complaint handled or any air pollution problem of special interest.

(5) Need to arrange meetings of field units for coordinated types of inspections or handling of emergencies in the field.

(6) In order for aerial observation to be of any practical use, a radio-communications system is necessary to transmit information from aerial to ground units.

(7) Field units must be able to receive special instructions and assignments as may be required.

Equipment available for these operations varies from devices which simply notify field employees that contact is desired to those instruments which permit complete and lengthy conversations.

In the former category are basic paging devices in use by many doctors today. These are small portable receivers, about the size of a small radio, that may attach to the user's belt. When activated, it produces a beep or whistle-type sound that indicates to the enforcement officer that he should call his office.

In order to carry on conversations, 2-way radios or telephones must be employed. Two-way radios operate over a communications frequency in the business band. A large investment in equipment (or leasing arrangement) is required for the mobile units, a base-station transmitter, an antenna and possibly a repeater station. The antenna must be placed on a tall building or on high terrain. Repeater stations are necessary if the area to be covered is not relatively flat. If many hills or mountains are in the region, the signals will have to be reproduced by a repeater station located at a high elevation.

The 2-way radios may be augmented through the use of hand-held portable units (walkie-talkies) that the enforcement officer may carry. Devices with long enough range to operate within the main radio system are very expensive and very likely unnecessary for most applications. However, less expensive, short range walkie-talkies are quite useful for a team checking out a plant. One member may be outside reading the smoke, while others are inside the complex, observing the operation of equipment.

Mobile telephones operate about as simply as home telephones and do not involve large equipment expenditures. The telephone company will place a unit in a truck, van or automobile for a flat installation fee. The user is not charged for repairs and has no additional expenses other than use charges. These could become rather prohibitive if the units are used a great deal and are expensive. Telephone systems can provide complete area coverage.

The telephone companies will shortly have available 1-way portable devices similar to the paging units discussed earlier. When a particular phone number is dialed, the portable device will beep, alerting the user to call his office.

In addition, the state or local agency may install a radio transmitter to be used specifically to notify selective industrial plants of alert or emergency conditions and to relay instructions and information. Accordingly, certain designated categories of industry would be required to have radio receiving equipment capable of monitoring agency broadcasts. They might be ordered to curtail or halt their operations for the duration of an air pollution episode.

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GLOSSARY

A

ABSORBER: A device utilized to extract selectively one or more elements of a gas stream from others by absorption in a liquid medium. Usually the process is performed in cylindrical towers packed with an inert material thus providing a large surface area for intimate contact between the rising gas and the falling liquid. (The process may also be carried out in a tower containing perforated trays in which the rising gas bubbles through the layer of liquid on the trays.)

ABSORPTION: A process in which one or more constituents are removed from a gas stream by dissolving them in a selective liquid solvent. This may or may not involve a chemical change.

ACCUMULATOR: A vessel for the temporary storage of a gas or liquid; usually used for collecting sufficient material for a continuous charge to a refining process.

ACID SLUDGE: The residue left after treating petroleum oil with sulfuric acid for the removal of impurities. It is a black, viscous substance containing the spent acid and impurities which have been separated from the oil.

ACID TREATMENT: An oil-refining process in which unfinished petroleum products, such as gasoline, kerosene, diesel fuel, and lubricating stocks, are contacted with sulfuric acid to improve color, odor, and other properties.

ACIDULATE: To make acid, especially slightly acid; to treat with acid.

ADDITION REACTION: Direct chemical combination of two or more substances to form a single product, such as the union of ethylene and chlorine to form ethylene dichloride:

$$C_2H_4 + Cl_2 \longrightarrow C_2H_4Cl_2$$

ADIABATIC LAPSE RATE: The rate at which a given mass of air lifted adiabatically (without loss or gain of heat) cools due to the decrease of pressure with increasing height, 5.4°F/1000 ft (9.7°C/km).

ADIABATIC PROCESS: A thermodynamic change of state of a system in which there is no transfer of heat or mass across the boundaries of the system.

ADIABATIC TEMPERATURE: (Combustion) The theoretical temperature that would be attained by products of combustion provided the entire chemical energy of the fuel, the sensible heat content of the fuel, and combustion air above the ambient temperature were transferred to the products of combustion. This assumes (1) that combustion is complete, (2) that there is no heat loss, (3) that there is no dissociation of the gaseous compounds formed, and (4) that inert gases play no part in the reaction.

ADSORPTION: A reaction in which one or more constituents (adsorbates) are removed from a gas stream by contacting and adhering to the surface of a solid (adsorbent). Periodically the adsorbent must be regenerated to remove the adsorbate.

AEROSOL: A colloidal system in which particles of solid or liquid are suspended in a gas. There is no clear-cut upper limit to the particle size of the dispersed phase in an aerosol, but as in all other collodial systems, it is commonly set at 1 micro-meter. Haze, most smoke, and some fogs and clouds may be regarded as aerosols.

AFTERBURNER: A burner located so that combustion gases are made to pass through its flame in order to remove smoke and odors.

AGGLOMERATION: Groups of fine particles clinging together to form a larger particle.

AIR ATOMIZING OIL BURNER: A burner in which oil is atomized by compressed air which is forced into and through one or more streams of oil thus breaking it into a fine spray.

AIR CURTAIN DESTRUCTOR: A device employing an air blower with pit incinerator. Excess oxygen and turbulence result in apparent complete combustion, leaving no residue unburned carbon (smoke) nor odorous hydrocarbons. The device has been satisfactorily demonstrated for disposal of low-ash, high-Btu waste, such as trees, tree trunks, brush (but not leaves), and wooden crating material. Excessive pollution results when materials such as automobile tires, cushions, and other non-wood wastes are burned.

AIR HEATER OR AIR PREHEATER: Heat transfer apparatus through which combustion air is heated by a medium of higher temperature, such as the products of combustion or steam.

ALKYLATION: In petroleum refining, usually the union of an olefin (ethylene through pentene) with isobutane to yield high-octane, branched-chain paraffinic hydrocarbons. Alkylation may be accomplished by thermal and catalytic reactions. Alkylation of benzene and other aromatics with olefins yields alkyl aromatics.

ALUMINA: Aluminum oxide (Al_2O_3), an intermediate product in the production of aluminum. This oxide also occurs widely in nature as corundum.

AMBIENT AIR: That portion of the atmosphere, external to buildings, to which the general public has access.

ANODE: In aluminum production, the positively charged carbon terminal in the reduction cell or pot. Oxygen is attracted to the anode where it combines with carbon plus any impurities, such as sulfur, which may be present. The anode is consumed by this process and must be replaced periodically.

ANTHRACITE COAL: A hard, black, lustrous coal containing a high percentage of fixed carbon and a low percentage of volatile matter. Commonly referred to as "hard coal," it is mined in the United States, mainly in eastern Pennsylvania, as well as in small quantities in other states.

AREA SOURCE: Any small residential, governmental, institutional, commercial, or industrial fuel combustion operations, as well as on-site waste disposal and transportation sources (see point source).

ASH: The noncombustible solid matter in fuel.

ASH-FREE BASIS: The method of reporting fuel analysis whereby ash is deducted and other constituents are recalculated to total 100 percent.

ASME: The American Society of Mechanical Engineers.

ASPIRATING BURNER: A burner in which the fuel in a gaseous or finely divided form is burned in suspension. The air of combustion is supplied by drawing it through one or more openings by the lower static pressure created by the velocity of the fuel stream.

ASTM: The American Society for Testing and Materials.

ATOMIZER: A device by means of which a liquid is reduced to a very fine spray.

ATMOSPERIC PRESSURE: The pressure due to the weight of the atmosphere. Normal atmospheric pressure at sea level is approximately 14.7 p.s.i. or 29.92 inches of mercury.

AVAILABLE HEAT: The quantity of useful heat per unit of fuel available from complete combustion after deducting dry flue gas and water vapor losses.

B

BAGASSE: Sugar cane from which the juice has been essentially extracted.

BAG FILTER: A device containing one or more cloth bags for recovering particles from the dust-laden gas which is blown through it.

BAGHOUSE: Structures containing several bag filters (see bag filters).

BAG-TYPE COLLECTOR: A filter wherein the cloth filtering medium is made in the form of cylindrical bags.

BANKING: Burning solid fuels on a grate at rates sufficient to maintain ignition only.

BARK BOILER: A combustion unit designed to burn mainly bark and wood residues, used to produce steam for process or electrical energy.

BAROMETRIC CONDENSER: An inexpensive direct contact condenser used when condensate recovery is not a factor. In this type of condenser, steam rises into a rain of cooling water, and both condensed steam and water flow out of the bottom of the condenser, maintaining a partial vacuum in the condenser.

BASE STOCK: A sheet, usually produced from unbleached kraft pulp, formed into linerboard on a fourdrinier machine.

BATCH FED INCINERATOR: An incinerator that is charged with refuse periodically, the charge being allowed to burn down or burn out before another charge is added.

BINDER: See core binder.

BITUMINOUS COAL: Soft coal, dark brown to black in color, having a relatively high proportion of gaseous constituents and usually burning with a smoky luminous flame.

BLACK LIQUOR: Spent chemical solution which is formed during the cooking of wood pulp in the digester. The black liquor is burned as a fuel in the recovery furnace.

BLAST FURNACE: A shaft furnace in which solid fuel is burned with an air blast to smelt ore.

BLEEDER: A bypass or relief valve used to relieve excess pressure.

BLISTER COPPER: An impure intermediate product in the refining of copper, produced by blowing copper bearing material in a converter; the name is derived from the large blisters on the cast surface that result from the liberation of SO_2 and other gases.

BLOWBACK: The difference between the pressure at which a safety valve opens and at which it closes, usually about three percent of the pressure at which the valve opens.

BLOWDOWN: Hydrocarbons purged during refinery shutdowns and startups which are manifolded for recovery, safe venting, or flaring.

BOILER: A closed pressure vessel in which the liquid, usually water, is vaporized by the application of heat.

BOILER HORSEPOWER: A unit of rate of water evaporation. One boiler horsepower equals the evaporation of 34.5 lb. of water per hour from a temperature of 212°F into dry saturated steam at the same temperature (equivalent to 33,472 Btu per hour).

BRASSESS: Copper-based alloy of 60-65% copper. Alloying material is usually zinc.

BREAKER: In anthracite mining, the structure in which the coal is broken, sized, and cleaned for market. Also known as a coal breaker. A machine used for the primary reduction of coal, ore, or rock.

BREECHING: A sheet-iron or sheet-metal casing at the end of boilers for conveying the smoke from the flues to the smokestack.

BRIGHTENING: The process of producing bright stock (see bright stock).

BRIGHT STOCK: Refined high viscosity lubricating oils usually made from residual stocks by suitable treatment, such as a combination of acid treatment or solvent extraction with dewaxing or clay finishing.

BRITISH THERMAL UNIT (Btu): The mean British thermal unit is 1/180 of the heat required to raise the temperature of one pound of water from 32°F to 212°F at a constant atmospheric pressure. It is about equal to the quantity of heat required to raise one pound of water 1°F. A Btu is essentially 252 calories.

BRONZES: Copper based alloy of 85-90% copper. Alloying material is usually tin.

BUNKER C OIL: Residual fuel oil of high viscosity commonly used in marine and stationary power plants (No. 6 fuel oil).

BURNER: A device for the introduction of fuel and air into a furnace at the desired velocities, turbulence, and concentration to establish and maintain proper ignition and combustion of the fuel.

BUSS (BUSBAR): A heavy metal conductor, usually copper, for high amperage electricity.

BUSTLE PIPE: In steel making, a metal tube of large diameter which surrounds a blast furnace at a level a little above the tuyeres; it is lined with refractory material and distributes the hot air from the blast stoves to the pipes (goosenecks) which carry the air to the tuyeres.

C

CALCINE: Ore or concentrate which has been treated by calcination or roasting and which is ready for smelting.

CALCINING: Roasting of ore in an oxidizing atmosphere usually to expel sulfur or carbon dioxide. If sulfur removal is carried to practical completion, the operation is termed "sweet roasting"; if all CO_2 is removed, the operation is termed "dead roasting."

CALORIE: The mean calorie is 1/1000 of the heat required to raise the temperature of one gram of water from 0°C to 100°C at a constant atmospheric pressure. It is about equal to the quantity of heat required to raise one gram of water 1°C.

CARBONIZATION: The process of converting coal to carbon in the absence of air by using intense heat to remove volative ingredients.

CARBON LOSS: The loss representing the unliberated thermal energy caused by failure to oxidize some of the carbon in the fuel.

CARCINOGENIC: Producing or tending to produce cancer.

CARRYOVER: The chemical solids and liquid entrained in the steam from a boiler or effluent from a fractionating column, absorber, or reaction vessel.

CATALYST: A substance capable of changing the rate of a reaction without itself undergoing any net change.

CATALYTIC CRACKING: The conversion of high boiling hydrocarbons into lower boiling substances by means of a catalyst which may be used in a fixed bed, moving bed, or fluid bed. Natural or synthetic catalysts are employed in bead, pellet, or powder form. Feedstocks may range from naphtha cuts to reduced crude oils.

CATHODE: In aluminum production, the negatively charged terminal of the reduction cell to which the aluminum migrates. The terminal consists of the carbon lining that makes up the bottom of the cell.

CAVING: In metal mining, caving implies the dropping of the over-burden as part of the system of mining.

CHARGING: Feeding raw material into an apparatus, for example, into a furnace, for treatment or conversion.

CHLOROSIS: A diseased condition in green plants marked by yellowing or blanching of the leaves.

CINDERS: Particles not ordinarily considered as fly ash or dust because of their greater size; these particles consist essentially of fused ash and/or unburned matter.

CLEANING FIRES: The act of removing ashes from the fuel bed or furnace.

CLINKERS, CEMENT: The glassy, stony, lump-like product of fusing together clay and limestone as the first stage in the manufacture of portland cement.

COAL DESULFURIZATION: See desulfurization.

COAL GAS: Gas formed by the destructive distillation of coal.

COAL TAR: A black viscous liquid formed as a by-product from the distillation of coal.

COKE: Bituminous coal from which the volatile constituents have been driven off by heat so that the fixed carbon and the ash are fused together.

COKE BREEZE: Fine coke particles leaving the coke quencher with the quenched coke by conveyor. The particles are very fine and may be blown away.

COKE, PETROLEUM: The solid carbonaceous residue remaining as the final product of the condensation processes in cracking. It consists of highly polycyclic aromatic hydrocarbons very poor in hydrogen. It is used extensively in metallurgical processes. Calcination of petroleum coke can yield almost pure carbon or artificial graphite suitable for production of electrodes, motor brushes, dry cells, etc.

COKING: 1. Carbonization of coal by destructive distillation. 2. In petroleum refining: any cracking process in which the time of cracking is so long that coke is produced as the bottom product; thermal cracking for conversion of heavy, low-grade oils into lighter products and a residue of coke; or the undesirable building up of coke or carbon deposits on refinery equipment.

COLLECTION EFFICIENCY: The ratio of the weight of pollutant collected to the total weight of pollutant entering the collector.

COLLOID: 1. A substance composed of extremely small particles, ranging from 0.005 micro-meters to 0.2 micro-meters, which when mixed with a liquid will not settle, but will remain suspended. The colloidal suspension thus formed has properties that are quite different from the simple solution of the two substances. 2. In fuel burning, a finely divided organic substance which tends to inhibit the formation of dense scale and results in the deposition of sludge, or causes it to remain in suspension, so that it may be blown from the boiler.

COLLOIDAL FUEL: Mixture of fuel oil and powdered solid fuel.

COMBINATION BOILER: A combustion unit used to produce steam for process or electrical energy which is designed to burn bark and at least one other fuel.

COMBUSTION CONTAMINANTS: Particulate matter discharged into the atmosphere from the burning of any kind of material containing carbon.

COMBUSTION TOWER: Refractory graphite-lined or water-jacketed stainless steel tower in which phosphorus is burned to phosphorus pentoxide.

CONDENSED FUMES: Minute solid particles generated by the condensation of vapors from solid matter after volatilization from the molten state, or generated by sublimation, distillation, calcination, or chemical reaction when these processes create airborne particles.

CONDENSER BOILER: A boiler in which steam is generated by the condensation of a vapor.

CONTACT CONDENSER: A condenser in which coolant, vapors, and condensate are mixed.

CONTINUOUS-FEED INCINERATOR: An incinerator into which refuse is charged in a nearly continuous manner in order to maintain a steady rate of burning.

CONTROL STRATEGY: A combination of measures designed to achieve the aggregate reduction of emissions necessary for attainment and maintenance of a national ambient air quality standard.

CONVECTION: The transmission of heat by circulation of a liquid or a gas. Convection may be natural or forced.

CONVERTER: 1. A furnace in which air is blown through a bath of molten metal or matte, oxidizing the impurities and maintaining the temperature through the heat produced by the oxidation reaction. 2. In nitric acid production, the chamber in which ammonia is converted to nitric oxide and water by reacting it with air over a platinum-rhodium catalyst.

CONVERTING: The process of removing impurities from molten metal or metallic compounds by blowing air through the liquid. The impurities are changed either to gaseous compounds, which are removed by volatilization, or to liquids or solids which are removed as slags.

CORE: The central part of a sand mold as used in foundries. The device placed in a mold to make a cavity in a casting.

CORE BINDER: Organic material added to foundry sand to aid in formation of a strong core for casting. Flour, linseed oil, starch, and resins are among materials used.

CRACKING: Chemical reaction by which large oil molecules are decomposed into smaller, lower-boiling molecules. At the same time, certain of these molecules, which are reactive, combine with one another to give even larger molecules than those in the original stock. The more stable molecules leave the system as cracked gasoline, but the reactive ones polymerize, forming tar and even coke. Cracking may be in either the liquid or vapor phase. When a catalyst is used to bring about the desired chemical reaction, this is called "catalytic cracking"; otherwise, it is assumed to be "thermal cracking" (see catalytic cracking).

CRACKLINGS: The crisp residue left after the fat has been separated from the fibrous tissue in rendering lard or frying or roasting the skin of pork, turkey, duck, or goose.

CRUSHER: A machine for crushing rock or other materials. Among the various types of crushers are the ball mill, gyratory crusher, Hadsel mill, hammer mill, jaw crusher, red mill, rolls, and stamp mill.

CRYOLITE: Sodium aluminum fluoride (Na_3AlF_6) used as an electrolyte in smelting of alumina to provide aluminum.

CULM: The fine refuse from anthracite coal production.

CUPOLA: A vertical shaft furnace used for melting metals, especially grey iron, by having the charge come in contact with the hot fuel, usually metallurgical coke. Metal, coke, and flux are charged from the top of the furnace onto a bed of hot coke through which air is blown.

CURTAIN WALL: A partition wall between chambers in an incinerator under which combustion gases pass.

CYCLONE: A structure without moving parts in which the velocity of an inlet gas stream is transformed into a confined vortex from which centrifugal forces tend to drive the suspended particles to the wall of the cyclone body. The particles then slide down the cyclone wall and are collected at the bottom.

CYCLONE SCRUBBERS: Devices ranging from simple dry cyclones with spray nozzles to multistage devices. All feature a tangential inlet to a cylindrical body.

CYCLONIC SPRAY TOWER: Liquid scrubbing apparatus where sprays are introduced countercurrent to gases for removal of contaminants.

D

DEHYDROGENATION: The removal of hydrogen from a chemical compound; for example, the removal of two hydrogen atoms from butane to make butylene, and the further removal of hydrogen to make butadiene.

DEMISTER (COLLECTOR): 1. A mechanical device used to eliminate finely divided liquid particles from process streams by impaction and agglomeration. 2. Apparatus made of wire mesh or glass fiber and used to eliminate acid mist as in the manufacture of sulfuric acid.

DESTRUCTIVE DISTILLATION: 1. A process of distillation in which an organic compound or mixture is heated to a temperature high enough to cause decomposition. 2. The heating of organic matter when air is not present, resulting in the evolution of volatile matter and leaving char consisting of fixed carbon and ash.

DESULFURIZATION: 1. In coal processing, the removal of sulfur from the coal, often by mechanical cleaning processes. 2. In petroleum refining, removing sulfur or sulfur compounds from a charge stock (oil that is to be treated in a particular unit).

DIFFUSION: The spreading or scattering of a gaseous or liquid material. 1. Eddy diffusion: diffusion caused by turbulent activity in a fluid system. 2. Molecular diffusion: a process of spontaneous intermixing of different substances, attributed to molecular motion and tending to produce uniformity of concentration.

DIRECT-FIRED BOILER: Commonly used to denote a boiler and furnace fired by pulverized coal.

DISPERSION: The dilution of a pollutant by diffusion, or turbulent action, etc. Technically, a two-phase system of two substances, one of which (the dispersed phase) is uniformly distributed in a finely divided state through the second substance (the dispersion medium). Either phase may be a gas, liquid, or solid.

DISTILLATE: The product of distillation obtained by condensing the vapors from a still.

DISTILLATE FUELS: Liquid fuels distilled usually from crude petroleum, except residuals such as No. 5 and No. 6 fuel oil.

DISTILLATE OILS: The lighter oils produced by distilling crude oil.

DISTILLATION: The process of heating a substance to the temperature at which it is converted to a vapor, then cooling the vapor, and thus restoring it to the liquid state.

DOCTOR TREATMENT: Treatment of gasoline with sodium-plumbite solution and sulfur to improve its odor.

DOPES FOR GASOLINES: Materials added in small amounts to gasoline to increase the octane number and thus help to prevent knocking.

DOUBLE DECOMPOSITION: A chemical reaction between two compounds in which part of the first compound becomes united with the remainder of the second, as: $AB + CD = AD + BC$.

DRAFT: A gas flow resulting from the pressure difference between the incinerator, or any component part, and the atmoshpere, which moves the products of combustion from the incinerator to the atmosphere. 1. Natural draft: the negative pressure created by the difference in density between the hot flue gases and the atmosphere. 2. Induced draft: the negative pressure created by the vacuum action of a fan or blower located between the incinerator and the stack. 3. Forced draft: the positive pressure created by the action of a fan or blower, which supplies the primary or secondary air.

DROP ARCH: A refractory construction or baffle which serves to deflect gases in a downward direction.

DROSS: 1. Impurity formed in melted metal. A zinc-and-iron alloy forming in a bath of molten zinc, in galvanizing iron. 2. The scum that forms on the surface of molten metals usually due to oxidation, but occasionally due to the rising of impurities to the surface.

DRUM, FLASH (OR FLASH TOWER): A drum or tower into which the heated outlet products of a preheater or exchanger system are conducted, often with some release in pressure. The purpose of the drum is to allow vaporization and separation of the volatile portions for fractionation elsewhere.

DRY BOTTOM FURNACE: A furnace designed to burn pulverized coal at temperatures low enough to prevent the ash from fusing or slagging.

DUST: Generally particles from 1 to 100 micro-meters in size that become airborne by natural or mechanical means. These particles do not diffuse but will settle under the influence of gravity (see also particle).

DUST COLLECTING FAN: A centrifugal fan which concentrates dust and skims it into a cyclone or hopper.

DUSTLESS LOADING: The amount of dust in a gas, usually expressed in grains per cubic foot or in pounds per thousand pounds of gas (see also grain loading).

E

ECONOMIZER: A heat recovery device designed to transfer heat from the products of combustion to a fluid, usually feedwater for a steam boiler. The water flows through a bank of tubes placed across the flue gases and is heated by these gases prior to entering the boiler.

EFFICIENCY: The ratio of output to input. The efficiency of a steam generating unit is the ratio of the heat absorbed by the water or steam to the heat in the fuel fired, expressed in percent.

EFFLUENT: Any waste material (solid, liquid, gas) emitted by a process.

EFFLUENT WATER SEPARATOR: A container designed to separate volatile organic compounds from waste water prior to discharge or reuse.

ELECTROLYSIS: 1. Chemical change resulting from the passage of an electric current through an electrolyte. 2. Transfer or transport of matter through a medium by means of conducting ions (positively or negatively charged particles). The medium may consist of fused salts or conducting solutions which permit free movement of ions toward the countercharged electrodes immersed in the system.

ELECTROSTATIC PRECIPITATOR: Devices that separate particles from a gas stream by passing the carrier gas between two electrodes across which a unidirectional, high-voltage electrical charge is placed. The particles pass through this field, become charged and migrate to the oppositely charged electrode. Single-stage precipitators are those in which gas ionization and particulate collection are combined into a single step. In the two-stage unit, ionization is achieved by one element of the unit and the collection by the other. Electrostatic precipitators are highly efficient collectors for minute particles.

ELUTRIATOR: A vertical tube through which a gas or fluid passes upward at a specific velocity while a solid mixture whose separation is desired is fed into the top of the column. The large particles which settle at a velocity higher than that of the rising fluid are collected at the bottom of the column, and the smaller particles are carried out of the top of the column with the fluid.

EMISSION: The total amount of a solid, liquid, or gaseous pollutant emitted into the atmosphere from a given source in a given time, and indicated in grams per cubic meter of gas, pounds per hour, or other quantitative measurement.

ENDOTHERMIC REACTION: A reaction which requires the addition of heat for its continuation.

ENTRAINMENT: The process of particulates or other materials being carried along by a gas stream.

EVAPORATOR: Usually a vessel which receives the hot discharge from a heating coil and, by a reduction in pressure, flashes off overhead the light products and allows the heavy residue to collect in the bottom (see flash tower).

EXCESS AIR: Air supplied for combustion in excess of that theoretically required for complete combustion, usually expressed as a percentage of theoretical air, such as "130 percent excess air."

EXOTHERMIC REACTION: A reaction which produces heat.

F

FABRIC FILTER: See bag filter.

FIXED CARBON: That part of the carbon which remains when coal is heated in a closed vessel until the volatile matter is driven off. It is the nonvolatile matter minus the ash.

FEEDSTOCK: Starting material used in a process. This may be raw material or an intermediate product that will undergo additional processing.

FLOATING ROOF: A special tank roof which floats upon the oil in a storage tank.

FLUE: Any duct, passage, or conduit through which the products of combustion are carried to a stack or chimney (see also breeching).

FLUE GAS: The gaseous products of combustion passing from the furnace into the stack.

FLUIDIZED ROASTING: Oxidation of finely ground pyritic minerals by means of upward currents of air, blown through a reaction vessel (fluid bed roaster) with sufficient force to cause the bed of material to expand (boil). Reaction between mineral and air is maintained at a desired exothermic level by control of oxygen entry, by admission of cooling water, or by addition of fuel.

FLUOROSIS: A chronic poisoning resulting from the presence of 0.9 milligrams or more per liter of fluorine in drinking water. Teeth become brittle and opaque white with a mottled enamel.

FLUOROSPAR: A natural calcium fluoride (CaF_2) used as a flux in open hearth steel furnaces and in gold, silver, copper, and lead smelting.

FLUX: 1. In chemistry and metallurgy, a substance that promotes the fusing of minerals or metals or prevents the formation of oxides. 2. A substance added to a solid to increase its fusibility. 3. A substance to reduce melting temperature. 4. Any chemical or rock added to an ore to assist in its reduction by heat, such as limestone with iron ore in a blast furnace.

FLY ASH: In incineration, suspended incombustible particles, charred paper, dust, soot, or other partially incinerated matter, carried in the gaseous products of combustion.

FOOD-GRADE ACID: Phosphoric acid that has been treated for removal of heavy metals and is suitable for use in food products.

FORCED DRAFT: See draft.

FRACTIONAL DISTILLATION: The separation of the components of a liquid mixture by vaporizing and collecting the fractions which condense in different temperature ranges.

FUEL: Any form of combustible matter--solid, liquid, vapor, or gas, excluding combustible refuse.

FUEL-BURNING EQUIPMENT: Any furnace, boiler, apparatus, stack, and all appurtenances thereto, used in the process of burning fuel for the primary purpose of producing heat or power by indirect heat transfer.

FUGITIVE DUST: Solid airborne particulate matter emitted from any source other than a flue or stack.

FUME: Fine solid particles predominately less than 1 micro-meter in diameter suspended in a gas. Usually formed from high-temperature volatilization of metals, or by chemical reaction.

FUMIGATION: Fumigation is an atmospheric phenomenon in which pollution, which has been retained by an inversion layer near its level of emission, is brought rapidly to ground level when the inversion breaks up. High concentrations of pollutant can thus be produced at ground level.

FUMING NITRIC ACID: A mixture of 98 percent nitric acid and an equilibrium mixture of nitrogen tetroxide (N_2O_4) and nitrogen dioxide (NO_2).

FURNACE OIL: A distillate fuel primarily intended for domestic heating use. No. 1 commercial standard grade is intended for "vaporizing" burners requiring a volatile fuel, whereas No. 2 and No. 3 commercial standard grades are less volatile, and are thus usable in the "atomizing" type of burners.

G

GAGE PRESSURE: The pressure above atmospheric pressure, expressed as pounds per square inch, gage (psig).

GOB PILES: Large piles of low-combustible refuse from coal mine preparation plants. Fires may develop in these waste material piles by liberation of heat through slow oxidation, until ignition temperature is reached (see also culm).

GRAIN LOADING: Concentration of particulates in exhaust gas, expressed as grains per standard cubic foot (7000 grains = 1 pound) (see also dust loading).

GRAVITATIONAL SETTLING: Removal of material from the atmosphere due to the action of gravity.

GREEN COKE: Coke that has not been fully cooked. Creen coke produces excessive emissions when pushed from a coke oven.

GREEN FEED (CALCINED FEED): Not fully processed or treated feed.

GROUT (GROUTING): A pumpable slurry of portland cement or a mixture of portland cement and fine sand commonly forced into a borehole to seal crevices in a rock to prevent ground water from seeping or flowing into an excavation or for extinguishing underground fires.

H

HEAT ISLAND EFFECTS: Meteorological characteristics of an urban area or large industrial complex which differentiates it from its surroundings. Generally, the urban area has (1) higher temperatures, (2) a less stable nocturnal lapse rate immediately above the surface, (3) lower relative humidities, (4) greater cloudiness, (5) more frequent fogs, (6) less incoming radiation, (7) lower wind speeds, and (8) greater precipitation.

HEAT RELEASE RATE: The amount of heat liberated during the process of combustion and expressed in Btu per hour per cubic foot of internal furnace volume in which the combustion takes place.

HOG FUEL BOILER: See bark boiler.

HOT BLAST MAIN: A duct lined with refractory material, through which hot air passes from a hot blast stove to the bustle pipe of a blast furnace.

HOT WELL: A reservoir for receiving warm condensed steam drawn from a condenser.

HYDRATOR-ABSORBER: A single or double tower in which phosphorus pentoxide is hydrated to phosphoric acid and the resulting acid mist is absorbed.

HYDRAULIC FLY ASH HANDLING: A system using water-filled pipes or troughs in which fly ash is conveyed by means of gravity, water jets, or centrifugal pumps.

HYDROCARBONS: Organic compounds which consist solely of carbon and hydrogen and occur in petroleum, natural gas and coal.

HYDROCRACKING: A low-temperature catalytic method of converting crude oil, residual oil, petroleum tar, and asphalt to high-octane gasoline, jet fuel, and/or high-grade fuel oil. The process combines cracking, hydrogenation, and isomerization.

HYDRODESULFURIZATION: A desulfurization process in which the oil is heated with hydrogen.

HYDROGENATION: The chemical addition of hydrogen to a material at high pressure in the presence of a catalyst.

HYDROMETALLURGY: The treatment of ores, concentrates, and other metal-bearing materials by wet processes, usually involving the solution of some component, and its subsequent recovery from the solution.

HYDROTREATING: A treating process using hydrogen for the desulfurization of cracked distillates.

I

IMPINGEMENT: In air sampling, impingement refers to a process for the collection of particulate matter in which the gas being sampled is directed forcibly against a surface. 1. Dry impingement: the process of impingement in the gas stream where particulate matter is retained upon the surface against which the stream is directed. The collecting surface may be treated with a film of adhesive. 2. Wet impingement: the process of impingement in a liquid which retains the particulate matter.

IMPINGEMENT SEPARATORS: Devices using the principle that when a gas stream carrying particulate matter impinges on a body, the gas is deflected around the body, while the particles, because of their greater inertia, tend to strike the body and be collected on its surface. The bodies may be in the form of plates, cylinders, ribbons, or spheres.

INCINERATION: The process of burning solid, semi-solid, or gaseous combustible waste.

INCINERATOR: An apparatus designed to burn solid, semi-solid, or gaseous waste leaving little or no combustible material (see multiple chamber incinerator).

INERTIAL SEPARATOR: The most widely used device for collecting medium and coarse sized particles. Inertial separators operate by the principle of imparting centrifugal force to the particle to be removed from the carrier gas stream.

INTERRUPTIBLE GAS: Gas sold whereby the seller may curtail or stop delivery, generally at his option. The gas customer under these conditions is expected to have standby equipment capable of taking over 100% of his needs by an alternate fuel.

INVERSION: A stratum in the atmosphere through which the temperature increases with height. The layer is thermally stable and vertical motion within the layer is suppressed.

INVERSION BASE: The lowest height in the atmosphere at which the temperature ceases to decrease with height.

ISOMERIZATION: A reaction which alters the fundamental arrangement of the atoms in a molecule without adding or removing anything from the original material. In the petroleum industry, straight-chain hydrocarbons are converted catalytically to branched-chain hydrocarbons of substantially higher octane number by isomerization.

J

JIG: A device which separates coal from foreign matter by means of their difference in specific gravity in a water medium. The water pulsates up and down causing the heavy material to work to the bottom.

K

KETTLE: 1. An open-top vessel used in carrying out metallurgical operations on low-melting-point metals; for example, in drossing and desilverizing lead. 2. An open or (usually) closed vessel for preparing paints, varnishes, and resins.

KILN: A furnace in which the heating operations do not involve fusion. Kilns are most frequently used for calcining, and free access of air is permitted. The raw materials may be heated by the combustion of solid fuel with which they are mixed, but more usually they are heated by gas or the waste heat from other furnaces.

KILN GAS: Hot effluent gases from a kiln. Unless controlled, these gases can be the largest source of particulates in a plant.

KNOCKOUT DRUM: A drum or vessel constructed with baffles through which a mixture of gas and liquid is passed to disengage one from the other. As the mixture comes in contact with the baffles, the impact frees the gases and allows them to pass overhead; the heavier substance falls to the bottom of the drum.

L

LAPSE RATE: The decrease of temperature with altitude.

LAUNDER: A trough, channel, or gutter usually of wood, by which water is conveyed. Specifically, in mining, a chute or trough for conveying powered ore, or for carrying water to or from the crushing apparatus.

LEACHING: Extracting a soluble metallic compound from an ore by selectively dissolving it in a suitable solvent, such as water, sulfuric acid, hydrochloric acid, etc.

LIGNITE COAL (BROWN COAL): A brownish-black variety of coal, usually high in moisture and low in Btu's. Lignite is one of the earlier stages in the formation of bituminous coal.

M

MANIFOLD: A pipe or header for collecting a fluid or gas from, or distributing a fluid or gas to, a number of pipes or tubes.

MANUFACTURED GAS: Fuel gas manufactured from coal, oil, etc., as differentiated from natural gas.

MATERIAL BALANCE: An accounting of the weights of material entering and leaving a process.

MATTE: A metallic sulfide mixture formed in smelting sulfide ores of copper, lead, and nickel.

MECHANICAL, CENTRIFUGAL SEPARATORS: A device for separating particulates. A rotating fan blade exerts a large centrifugal force on the particulates, ejecting them from the tips of the blades to a skimmer bypass leading into a dust hopper.

MECHANICAL SCRUBBER: A scrubber in which the water spray is generated by a rotating element or disk (see also scrubber).

MECHANICAL TURBULENCE: In meteorology, the induced eddy structure of the atmosphere due to the roughness of the surface over which the air is passing. The height and spacing of the elements causing the roughness will affect the turbulence.

MERCAPTANS: Organic compounds having the general formula R-SH (where R represents any hydrocarbon radical) which are analogous to the alcohols and phenols but which contain sulfur in place of oxygen. The simpler mercaptans have strong, repulsive odors.

MESH: The number of holes per linear unit in a sieve or gauze, or the space between the wires of the sieve expressed in inches or millimeters.

METRIC TON: 2204.6 pounds or 1000 kilograms.

MIST: A suspension of any finely divided liquid in a gas.

MODIFIED COAL: Coal of a stoker size containing a controlled percentage of fines.

MULTICYCLONE (ALSO MULTIPLE CYCLONE OR MULTICLONE): A dust collector consisting of a number of cyclones, operating in parallel, through which the volume and velocity of gas can be regulated by means of dampers to maintain dust-collector efficiency over the load range.

MULTIPLE-CHAMBER INCINERATOR: Any incinerator consisting of a primary combustion chamber, mixing chamber, and secondary combustion chamber in series. The chambers are separated by refractory walls, and interconnected by gas passage ports.

MULTIPLE-HEARTH TYPE ROASTER: See roasting furnace.

MUNICIPAL INCINERATOR: An incinerator owned or operated by government or by a person who provides incinerator service to government or others; a device designed for and used to burn waste materials of any and all types.

N

NATURAL GAS: Gaseous forms of petroleum occurring in nature and used directly as a fuel. Natural gas consists of mixtures of hydrocarbon gases and vapors, the more important of which are methane, ethane, propane, and butane.

NET TON: 2000 pounds (sometimes known as a "short ton").

NITROGEN OXIDES: A general term pertaining to a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2).

O

ODORANT: A gaseous nuisance that is offensive or objectionable to the smell.

ODOR INTENSITY: The numerical or verbal indication of the strength of an odor.

ODOR PERVASIVENESS: The ability of an odor to diffuse into a large volume of air and still continue to possess a detectable intensity. A pervasive odor is one whose odor intensity changes very little on dilution.

ODOR QUALITY: A verbal description of an odor. The quality may be described in terms of such familiar odorants as coffee, onions, lemons, or by associating an unfamiliar odor with a familiar odor.

ODOR THRESHOLD: The lowest concentration of an odor in air that can be detected by a human.

ODOR UNITS: That quantity of odor necessary to contaminate one cubic foot of air to threshold or barely perceptible level. The number of odor units is equal to the volumes (scf) of air necessary to dilute the concentration of odorant in one volume (scf) of air to the threshold concentration.

OIL BURNER: Any device for the introduction of vaporized or atomized fuel oil into a furnace.

OIL-EFFLUENT WATER SEPARATOR: Any tank, box, sump, or other container in which any petroleum product entrained in water is physically separated and removed prior to out-fall, drainage, or recovery of the water.

OITICICA (OIL): A drying oil obtained from the kernels of the fruit of the oiticica tree that is similar to tung oil in many properties and is used chiefly in varnishes, paints, and printing inks.

OLEORESIN: A varnish or paint vehicle, made of plant oils and resins, usually cooked.

OLEUM (FUMING SULFURIC ACID): A heavy, oily, strongly corrosive liquid that consists of a solution of sulfur trioxide in anhydrous sulfuric acid. It fumes in moist air and reacts violently with water.

ONSTREAM TIME: The length of time a unit is in actual production.

OPACITY: The degree to which emissions reduce the transmission of light and obscure the view of a distant object.

OPEN BURNING: The burning of any matter in such a manner that the products of combustion are emitted directly into the ambient air without passing through a stack, duct, or chimney.

OPEN HEARTH FURNACE: Reverberatory furnace, containing a basin-shaped hearth, for melting and refining suitable types of pig iron, iron ore, and scrap for steel production.

ORE AND LIME BOIL: Reactions which occur in an open hearth furnace when carbon monoxide is produced by the oxidation of carbon. Ore boil is a violent agitation of the metal as it escapes during this process; lime boil occurs when the limestone decomposes and the carbon dioxide gas escapes. The second reaction begins before the first is completed.

ORGANIC SULFUR: The difference between the total sulfur in coal and the sum of the pyritic sulfur and sulfate sulfur.

ORGANOLEPTIC: Affecting or making an impression upon one or more of the sense organs.

ORIFICE SCRUBBERS: Devices for the removal of particulates from gas streams in which the flow of air through a restricted passage partially filled with water causes the dispersion of the water and consequent wetting and collection of the particulates.

ORSAT: An apparatus used for analyzing flue gases volumetrically.

OVERBURDEN: Material of any nature, consolidated or unconsolidated, that overlies a deposit of useful material, ores, or coal, especially those deposits that are mined from the surface by open cuts.

OVERFIRE: Air for combustion admitted into the furnace at a point above the fuel bed.

OXIDATION: The act or process of combining oxygen with a substance, with or without the production of a flame.

OXYGEN LANCING: In steel making, a procedure in which oxygen is injected into the bath of molten metal through a water cooled lance. The oxygen oxidizes carbon, silicon, manganese, and some iron in exothermic reactions. The procedure materially shortens the time needed to tap the furnace.

P

PACKED COLUMN (PACKED SCRUBBER OR PACKED TOWER): A vertical column used for distillation, absorption, and extraction, containing packing; e.g., Raschig rings, Berl saddles, or crushed rock, which provide a large contacting surface area between phases. Normally, gas flow is countercurrent to liquid flow.

PAN: Peroxyacyl nitrates. Secondary pollutants formed in photochemical oxidation and major eye irritants of photochemical smog.

PARTICLE CONCENTRATION: Concentration expressed in terms of number of particles per unit volume of air or other gas.

PARTICULATE MATTER: Any dispersed matter, solid or liquid, in which the individual aggregates are larger than single small molecules (0.0002 micrometers) but smaller than 500 micro-meters.

PERCOLATOR: A device used in rendering plants for the separation of dry proteinaceous crackling from the clear moisture-free tallow. They are generally perforated pans which allow the tallow to drain away from the cracklings.

PERFORMANCE TEST: Measurements of emissions used for the purpose of determining compliance with a standard of performance.

PETROCHEMICAL INDUSTRY: A branch of the petroleum industry in which refined crude oil is manufactured into various chemicals.

PETROLEUM COKE: See coke, petroleum.

PHOTOCHEMICAL REACTION: A chemical reaction which involves either the absorption or emission of radiation in the form of light energy.

PLUME: The path taken by the continuous discharges of products from a chimney or stack. The shape of the path and the concentration distribution of gas plumes is dependent on turbulence of the atmosphere.

POINT SOURCE: Any stationary emitting point or plant/facility whose summation of emitting points totals 100 tons (or some other fixed amount) per year of any pollutant in a given region.

POLYCYCLIC MOLECULE: A molecule containing two or more fused rings (as in anthracine).

POLYMERIZATION: 1. A reaction combining two or more molecules to form a single molecule having the same elements in the same proportions as in the original molecules. 2. The union of light olefins to form hydrocarbons of higher molecular weight. The process may be thermal or catalytic.

POLYNUCLEAR AROMATIC HYDROCARBONS: Compounds consisting of two or more aromatic rings which share a pair of carbon atoms. The simplest and most important is naphthalene ($C_{10}H_8$; also polycyclic).

PRECLEANERS: Collectors of limited efficiency used ahead of the final cleaner. If the gas contains an appreciable amount of hard, coarse particles, a precleaner can materially reduce erosive wear of the more efficient final collector.

PRECURSORS: Gaseous air pollutants which react with other substances in the atmosphere to produce different pollutants; e.g., photochemical reactions of NO and NO_2 with the oxygen of the air which produce ozone.

PRILLING: A combination spray drying and crystallization technique used in the production of ammonium nitrate. A hot ammonium nitrate solution is sprayed in the top of a tower, and air is blown in at the bottom. The liquid is converted into spherical pellets.

PRIMARY AIR: In incineration, air which is introduced with the refuse into the primary chamber.

PRIMARY EMISSION: Pollutants emitted directly into the air from identifiable sources.

PRIMARY STANDARD: The national primary ambient air quality standard which defines levels of air quality which are necessary to protect public health.

PROCESS WEIGHT: The total weight of all materials introduced into a source operation, including solid fuels, but excluding liquids and gases used solely as fuels, and excluding air introduced for purposes of combustion.

PUG MILL: A machine for mixing water and clay which consists of a long horizontal barrel within which is a long longitudinal shaft fitted with knives which slice through the clay, mixing it with water which is added by sprayers from the top. The knives are canted to give some screw action, forcing the clay along the barrel and out one end.

PUMP, RECIPROCATING: A positive-displacement type of pump consisting of a plunger or a piston moving back and forth within a cylinder. With each stroke of the plunger or piston, a definite volume of liquid is pushed out through the discharge valves.

PYRITIC SULFUR: Sulfur combined with iron, found in coal.

PYROLYSIS: Chemical change brought about by the action of heat upon a substance.

PYROMETER: An instrument for measuring temperatures beyond the range of thermometers.

R

RECOVERY BOILER: In wood pulping, a combustion unit designed to recover the spent chemicals from the cooking liquor and to produce steam for pulping and recovery operations.

REDUCTION: 1. The addition of hydrogen or the abstraction of oxygen from a substance. 2. The extraction of any metal from its ore.

REFINERY GAS: Any form or mixture of still gas gathered in a refinery from the various stills.

REFINING: In metallurgy, the removal of impurities necessary to produce an ingot or alloy of desired specification. In petroleum, the process of separating, combining, or rearranging petroleum oil constituents to produce salable products.

REFORMING: The thermal or catalytic conversion of naphtha into more volatile products of higher octane number. It represents the total effect of numerous reactions, such as cracking, polymerization, dehydrogenation, and isomerization, taking place simultaneously.

REFRACTORY: A ceramic material of a very high melting point with properties that make it suitable for such uses as furnace and kiln linings.

RERUN OIL: Oil which has been redistilled.

RESIDUAL: Heavy oil left in the still after gasoline and other distillates have been distilled off, or residue from the crude oil after distilling off all but the heaviest components.

RESISTIVITY: The property of a body whereby it opposes and limits the passage of electricity through it. Resistivity of dust is an important factor in the performance of electrostatic precipitators. If the resistivity of the collected dust is higher than about 2×10^{10} ohm-cm, excessive arcing or reverse corona can occur, thereby limiting precipitator performance.

REVERBERATORY FURNACE: A furnace with a shallow hearth; having a roof that deflects the flame and radiates heat toward the surface of the charge. Firing may be with coal, pulverized coal, oil, or gas.

RINGELMANN CHART: A standardized chart giving shades of gray by which the densities of columns of smoke rising from stacks may be compared.

ROAST: To heat to a point somewhat short of fusing, with access to air, so as to expel volatile matter or effect oxidation. In copper metallurgy, applied specifically to the final heating which causes self-reduction to occur by the reaction between the sulfide and the oxide.

ROASTER: 1. A contrivance for roasting, or a furnace for drying salt cake. 2. A reverberatory furnace or a muffle used in roasting ore.

ROASTING: 1. Heating an ore to effect some chemical change that will facilitate smelting. 2. The heating of solids, frequently to promote a reaction with a gaseous constituent in the furnace atmosphere.

ROASTING FURNACE: A furnace in which finely ground ores and concentrates are roasted to eliminate sulfur; heat is provided by the burning sulfur.

RUN OF MINE COAL: Unscreened bituminous coal as it comes from the mine.

S

SALAMANDER: A small portable incinerator, or a small portable heater burning coke or oil.

SCRUBBER: A device used to remove entrained liquids and solids from a gas stream by passing the gas through wetted "packing" or spray (see absorber).

SECONDARY AIR: Air introduced into a combustion chamber beyond the point of fuel and primary air introduction for the purpose of achieving more complete oxidation.

SECONDARY STANDARD: The national secondary ambient air quality which defines levels of air quality judged necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

SINTERING: A heat treatment that causes adjacent particles of material to cohere or agglomerate at a temperature below that of complete melting.

SKIMMING PLANT: An oil refinery designed to remove and finish only the lighter constituents from the crude oil, such as gasoline and kerosene. In such a plant the portion of the crude remaining after the above products are removed is usually sold as fuel oil.

SKIP HOIST, INCLINED: A bucket or can operating up and down, receiving, elevating, and discharging bulk materials.

SLAG: The non-metallic top layer which separates from the metallic products in smelting of ores.

SLOP OR SLOP OIL: A term rather loosely used to denote odds and ends of oil produced at various places in a plant, which must be rerun or further processed in order to get in suitable condition for use. When good for nothing else, such oil usually goes into pressure-still charging stock, or to coke stills.

SMELT: In wood pulping, the molten chemicals from the kraft recovery furnace consisting mostly of sodium sulfide and sodium carbonate.

SMELTING: Any metallurgical operation in which metal is separated by fusion from impurities with which it may be chemically combined or physically mixed, such as in ores.

SMOKE: Small gas-borne particles resulting from incomplete combustion, consisting predominantly but not exclusively of carbon, ash, and other combustible material, and present in sufficient quantity to be observable.

SMOKE CANDLE(S): Apparatus used in collecting acid mists. Tubes or candles made from glass or plastic fibers are pressed into pads with thicknesses up to 2 inches and mounted in banks. Efficiency is much increased when the glass is treated with silicone oil to repel water, or when normally water-repellent plastic is used.

SMOKE UNIT: The number of "smoke units" is obtained by multiplying the smoke density in Ringelmann numbers by the time of occurrence in minutes. For the purpose of this calculation, a Ringelmann density reading is made at least once per minute during the period of observation. The sum of the Ringelmann density readings (made once per minute) during the period of observations would equal the number of smoke units.

SOILING: Visible damage to materials by deposition of air pollutants.

SOOT: Agglomerated particles consisting mainly of carbonaceous material.

SOUR: Gasolines, naphthas, and refined oils are said to be "sour" if they show a positive "doctor test"; i.e., if they contain hydrogen sulfide and/or mercaptans. Sourness is directly connected with odor, while a "sweet" gasoline has a good odor.

SOURCE: Any property, real or personal, or person contributing to air pollution.

SOURCE SAMPLE: A sample of the emission from an air contamination source, collected for analysis from within a stack.

SPARK ARRESTOR: A screenlike device to prevent sparks, embers, and other ignited materials larger than a given size from being expelled to the atmosphere.

SPEISS: Metallic arsenides and antimonides smelted from cobalt and lead ores.

SPRAY CHAMBER: The simplest type of scrubber consisting of a chamber in which spray nozzles are placed. They are used extensively as gas coolers because they have a low collection efficiency for anything but coarse particles.

STABILITY (STATIC STABILITY): The state of the atmosphere when it is stable relative to vertical displacements.

STACK OR CHIMNEY: Any flue, conduit, or duct arranged to conduct an effluent to the open air.

STACK SPRAY: A nozzle or series of nozzles installed in a stack above the breeching, used to inject wetting agents at high pressure to suppress the discharge of particulate matter from the stack.

STANDARD CONDITIONS: For source testing, 70°F (21.1°C) and 29.92" Hg (760mm Hg); for air quality measurements, 77°F (25°C) and 29.92" Hg (760mm Hg);

for chemistry, 273.1°K (0°C) and one atmosphere (760mm Hg); for petroleum refining, 60°F (15.55°C) and 14.7 psi (760mm Hg).

STATIONARY SOURCE: Any non-mobile building, structure, facility, or installation which emits or may emit any air pollutant.

STEAM DISTILLATION: Introduction of "open" steam into the liquid during distillation to assist in vaporizing the volatiles at a lower temperature.

STILL: A closed chamber, usually cylindrical, in which heat is applied to a substance to change it into vapor, with or without chemical decomposition. The substance, in its vapor form, is conducted to some cooling apparatus where it is condensed, liquefied, and collected in another part of the unit.

STOCK: In general, any oil which is to receive further treatment before going into finished products.

STOKER: A machine for feeding coal into a furnace, and supporting it there during the period of combustion. It may also perform other functions, such as supply air, control combustion, or distill volatile matter. Modern stokers may be classified as overfeed, underfeed, and conveyor. Any mechanical device that feeds fuel uniformly onto a grate or hearth within a furnace may be termed a "stoker."

STOPING: In mining, any process of excavating ore which has been made accessible by shafts and drifts.

STRAIGHT-RUN DISTILLATION: Continuous distillation which separates the products of petroleum in the order of their boiling points without cracking.

STRIPPER: Equipment in which the lightest fractions are removed from a mixture. In a natural-gasoline plant, gasoline fractions are stripped from rich oil. In the distillation of crude petroleum, light fractions are stripped from the various products.

SUBSTITUTION: A chemical reaction in which one or more atoms or groups of a molecule are replaced by equivalent atoms or groups to form at least two products, especially the replacement of hydrogen in an organic compound by another element or group.

SULFIDITY: An expression of the percentage makeup of chemical kraft cooking liquor obtained by the formula

$$\frac{Na_2S}{Na_2S + NaOH} \times 100$$

where the sodium compounds are expressed as Na_2O.

SUPERPHOSPHATE: Products obtained by mixing phosphate rock with either sulfuric or phosphoric acid, or both.

SURFACE CONDENSERS: A condenser in which the coolant does not contact the vapors or condensate. Most are of the tube and shell type. Water flows inside the tubes and vapors condense on the shell side.

SURGE TANK: A storage reservoir at the downstream end of a feeder pipe to absorb sudden rises of pressure and to furnish liquid quickly during a drop in pressure.

SWEETENING: The process by which petroleum products are improved in odor and color by oxidizing or removing the sulfur-containing and unsaturated compounds.

SYNERGISM: Cooperative action of discrete agents such that the total effect is greater than the sum of the two effects taken independently.

SYNTHETIC CRUDE: The total liquid, multi-component mixture resulting from a process involving molecular rearrangement of charge stock. Term commonly applied to the product from cracking, reforming, visbreaking, etc.

T

TAIL OIL: That portion of an oil which vaporizes near the end of the distillation; the heavy end.

TAIL GAS: The exhaust or waste gas from a process.

TALLOW: The rendered fat of animals that is white and almost tasteless when pure, composed of glycerides of fatty acids containing a large proportion of palmitic acid and stearic acid, and that is used chiefly in making soap, glycerol, margarine, candles, and lubricants.

TAPPING: Removing molten metal from a furnace.

TEMPERATURE INVERSION: An atmospheric layer in which temperature increases with altitude. The principal characteristic of a temperature inversion is its marked static stability, so that very little turbulent exchange can occur within it (see also inversion).

THEORETICAL AIR: The exact amount of air (stoichiometric air) required to supply the oxygen necessary for the complete combustion of a given quantity of a specific fuel or refuse.

THERMAL TURBULENCE: Air movement and mixing caused by temperature differences.

TOPPED CRUDE PETROLEUM: A residual product remaining after the removal, by distillation, of an appreciable quantity of the more volatile components of crude petroleum.

TOPPING: The distillation of crude oil to remove light fractions only.

TOTAL REDUCED SULFUR COMPOUNDS (TRS): Malodorous gases produced in the wood pulping industry exclusive of sulfur oxides. TRS usually includes hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), dimethyl sulfide (CH_3SCH_3), and dimethyl disulfide (CH_3SSCH_3). The concentration of TRS is usually expressed as H_2S regardless of the constituent compounds.

TURBULENCE: Atmospheric motions which produce a thorough horizontal and vertical mixing of the air.

TURNAROUND: The time between shutting down and starting up of process equipment for repair or maintenance.

TUYERES: Openings or nozzles in a metallurgical furnace through which air is blown as part of the extraction or refining process.

TWADDELL DEGREES (°TW): A measure of acid density and strength:

$$°TW = \frac{\text{sp. gr. } (60°/60°F) - 1}{0.005}$$

Each twaddell degree corresponds to a specific gravity interval of 0.005.

U

ULTIMATE ANALYSIS (OF COAL): Contains the following, expressed in percent by weight:

Carbon	(C)	%
Hydrogen	(H_2)	%
Sulfur	(S)	%
Oxygen	(O_2)	%
Nitrogen	(N_2)	%
Moisture	(H_2O)	%
Ash	(H_2O)	%
		100.0%

UNDERFEED STOKER: A stoker consisting of a trough or pot-shaped report into which coal is forced by an endless screw or ram. Coal is fed to the fire zone by being pushed up from underneath.

UNIT OPERATION: 1. Methods by which raw materials may be altered into states, such as vapor, liquid, or solid without being changed into new substances with different properties and composition. 2. Recognition, study, application and control of the principles and factors utilized in a distinct and self-contained process (for example, filtration). This avoids the duplication of effort which attends the study of similar processes as though each process involved a unique set of principles.

UNIT PROCESS: 1. Reactions where raw materials undergo chemical change. 2. See unit operation (2).

UREA FORMS: A urea-formaldehyde reaction product that contains more than one molecule of urea per molecule of formaldehyde.

V

VACUUM JET (STEAM JET EJECTOR): A fluid nozzle that discharges a high velocity jet stream across a section chamber that is connected to the equipment to be evacuated. The gas in the chamber is entrained by the jet stream.

VAPOR: The gaseous phase of a substance that generally exists as a liquid or solid at room temperature.

VAPOR PLUME: The stack effluent consisting of flue gas made visible by condensed water droplets or mist.

VAPOR RECOVERY SYSTEM: System used in petroleum refining for separating a mixed charge of miscellaneous gases and gasolines into desired intermediates for further processing.

VENTURI SCRUBBER: A type of high energy scrubber in which the waste gases pass through a tapered restriction (venturi) and impact with low-pressure water. Gas velocities at the restriction are from 15,000 to 20,000 fpm and pressure drops from 10 to 70 inches water gage.

VISBREAKING: Viscosity breaking; lowering or "breaking" the viscosity of residual oil by cracking at relatively low temperatures.

VISIBILITY: In United States weather observing practice, the greatest distance in a given direction at which it is just possible to see and identify with the unaided eye (a) in the daytime, a prominent dark object against the sky at the horizon, and (b) at night, a known, preferably unfocused, moderately intense light source. After visibilities have been determined around the entire horizon circle, they are resolved into a single value of prevailing visibility for reporting purpose.

VISIBLE EMISSION: An emission of air pollutants greater than 5 percent opacity or 1/4 Ringelmann.

VOLATILE OR VOLATILE MATTER: 1. The gasoline constituents that can be driven off liquids and solids by the application of heat. 2. Specifically for coal, that portion which is driven off in gas or vapor form when coal is subjected to a standardized temperature test.

VOLATILE ORGANIC COMPOUNDS: Any compound containing carbon and hydrogen or containing carbon and hydrogen in combination with any other element which has a vapor pressure of 1.5 pounds per square inch absolute or greater under actual storage conditions.

W-X-Y-Z

WASTE HEAT BOILERS: Boilers which utilize the heat of exhaust gas or process gas to generate steam or to heat water.

WEAK WASH: In wood pulping, a liquid stream in the kraft process which results from washing of the lime mud.

WET COLLECTORS: Devices which use a variety of methods to wet the contaminant particles in order to remove them from the gas stream (see scrubbers).

WET FILTERS: A spray chamber with filter pads composed of glass fibers, knitted wire mesh, or other fibrous materials. The dust is collected on the filter pads.

WHITE LIQUOR: Cooking liquid used in the wood pulping industry. Kraft process: consists of approximately 1/3 sodium sulfide (Na_2S) and 2/3 sodium hydroxide (NaOH). Sulfite process: consists of sulfurous acid plus one of the following: calcium bisulfite, sodium bisulfite, magnesium bisulfite, or ammonium bisulfite.

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